



VHX24E SHOWN

## VHX BOILER BASE SERIES HIGH EFFICIENCY ELECTRIC STEAMER

VHX24E	ML-126852
VHX24E5	ML-126853
MHB24E	ML-126857 (BASE ONLY)

**- NOTICE -**

This Manual is prepared for the use of trained Vulcan Service Technicians and should not be used by those not properly qualified. If you have attended a Vulcan Service School for this product, you may be qualified to perform all the procedures described in this manual.

This manual is not intended to be all encompassing. If you have not attended a Vulcan Service School for this product, you should read, in its entirety, the repair procedure you wish to perform to determine if you have the necessary tools, instruments and skills required to perform the procedure. Procedures for which you do not have the necessary tools, instruments and skills should be performed by a trained Vulcan Service Technician.

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# TABLE OF CONTENTS

GENERAL .....	4
Installation, Operation and Cleaning .....	4
Introduction .....	4
Steam Cooking .....	4
Model Designations .....	4
Compartment Pan Capacity .....	4
Cooking Compartments Control Panel .....	4
Boiler Control Panel .....	4
Boiler Code Descriptions .....	5
Water Conditioning .....	5
Specifications .....	5
Boiler Pressure .....	5
Water Supply .....	5
Electrical .....	6
Tools .....	6
REMOVAL AND REPLACEMENT OF PARTS .....	7
Pressure Switch Control Box Components .....	7
Main Control Box Components .....	8
Water Level Gauge Assembly .....	9
Heating Elements .....	10
Heating Element Mounting Plate .....	11
Boiler Assembly .....	12
Descaler (Cathodic Protector) .....	13
Cooking Compartment Door(s) .....	14
SERVICE PROCEDURES AND ADJUSTMENTS .....	16
Boiler .....	16
Inspection .....	16
Clean-Out .....	16
Deliming .....	16
Descaler (Cathodic Protector) .....	16
Water Level Probe Housing Blowdown .....	17
Water Level Controls Test .....	17
Cycling Pressure Switch Adjustment .....	19
High Limit Pressure Switch Adjustment .....	20
Boiler Fill and Cold Water Condenser Solenoid Valves .....	20
Cold Water Condenser Thermostat Adjustment .....	21
Heating Element Test .....	22
Cooking Compartment .....	22
Intake Shut-Off Valve Adjustment (Steam Flow) .....	22
Door Sealing Adjustment .....	23
Door Latch Adjustment .....	23

ELECTRICAL OPERATION .....	24
Component Function .....	24
Cabinet Base Boiler Controls .....	24
Cooking Compartment Controls .....	25
Component Locations .....	26
Boiler Base Controls .....	26
Cooking Compartment Controls .....	28
Water Level Controls .....	29
Low Level Cut-Off & Differential Control .....	29
Auxiliary Low Level Cut-Off .....	30
Relay Board .....	31
Layout, Legend & Diagnostic Test Points .....	31
Schematic .....	32
Sequence of Operation .....	33
Cooking Compartment Controls .....	34
Schematics .....	36
Boiler Base Controls .....	36
Cooking Compartment Controls .....	37
Wiring Diagrams .....	38
Boiler Base Controls .....	38
Heating Element Circuits .....	40
Cooking Compartment Controls .....	41
 TROUBLESHOOTING .....	 42
 CONDENSED SPARE PARTS LIST .....	 48

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# GENERAL

## INSTALLATION, OPERATION AND CLEANING

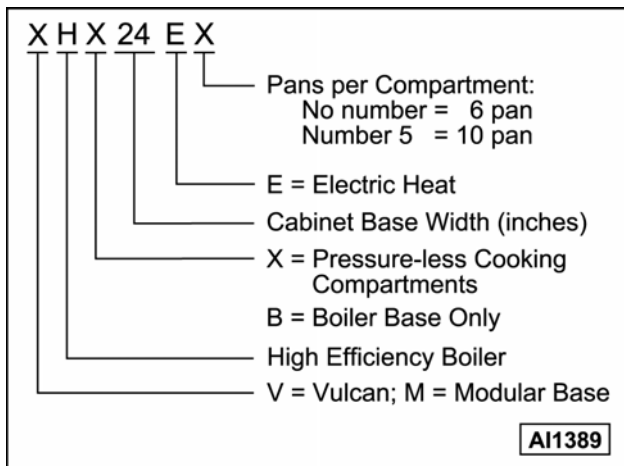
Refer to the Installation and Operation Manual for specific instructions.

## INTRODUCTION

### Steam Cooking

Convection cooking in pressure-less steaming compartments will steam cook fresh foods or will steam defrost and cook frozen foods providing the maximum color, flavor and nutritional value with the least expenditure of energy and labor. The pressure-less steaming compartments on the VHX series, allows the operator to open and close the door anytime during a cooking cycle. The steam supply will shut off when the door is opened, then re-start when the door is closed.

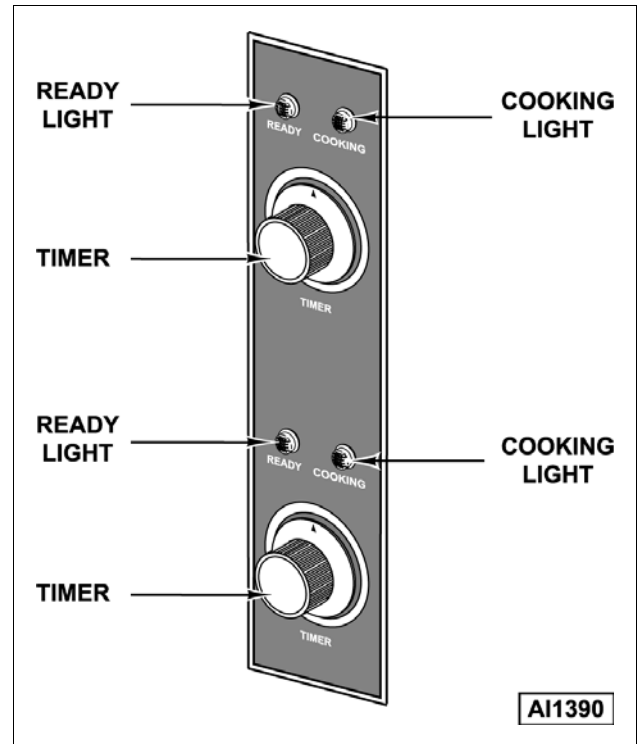
### Model Designations



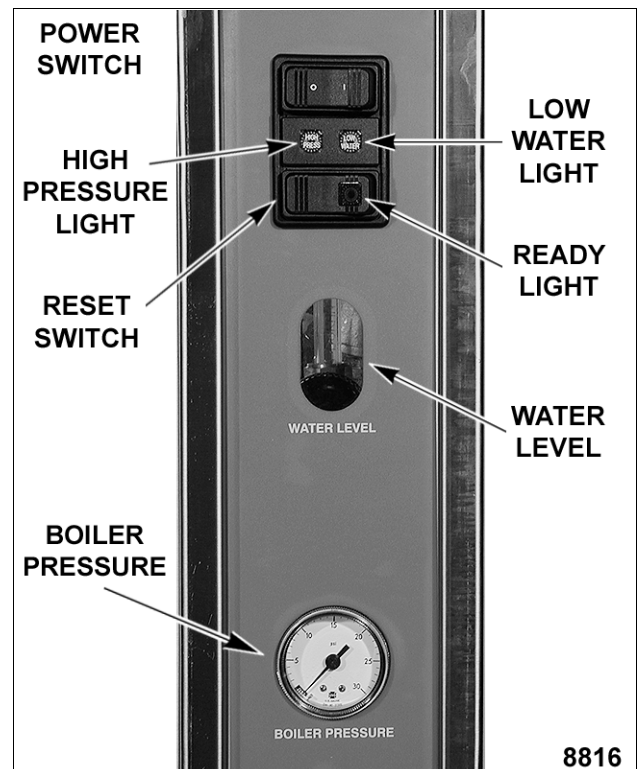
### Compartment Pan Capacity

MODEL	NUMBER OF PANS PER COMPARTMENT	PAN DEPTH (INCHES)
VHX24E	2	4.0
	3	2.5
	6	1.0
VHX24E5	3	4.0
	5	2.5
	10	1.0
Pan Size 12" x 20"		

### Cooking Compartments Control Panel



### Boiler Control Panel



**Boiler Code Descriptions**

Vulcan-Hart incorporates redundant controls in compliance with the CSD-1 controls and safety devices for boiler construction on the high efficiency steamer models. A description of the code is listed below.

CSD-1 Construction - Redundant controls in the electrical safety circuits that, if tripped, must manually be reset after the condition causing the trip subsides. The controls provide low water level cut-off protection (LLCO), auxiliary low water level cut-off protection (Aux LLCO), and high pressure protection for the boiler. Additionally, the low water and high pressure safety circuits have individual indicator lights that will illuminate for a visual verification of the shutdown mode.

CSD-1 construction requires operator intervention in the event of a shutdown. The indicator lights show the operator which safety system was shutdown.

**WATER CONDITIONING**

Furnishing the boiler with treated water to reduce scale formation is advised. Scale formation will reduce steam output, cause premature component failure, and shorten equipment life. Most water supplies contain scale producing minerals such as calcium and magnesium. As steam is generated, the minerals remain and dissolve into the water. As the concentration of these minerals increases past a certain point, they precipitate from the water and coat the inside of the boiler, heating elements, and water level sensors. Because of the high temperature of these surfaces, the precipitated minerals bake onto them and become very difficult to remove.

This may cause several problems:

1. Reduced heat transfer efficiency.
2. Premature heating element failures.
3. False readings from water level sensors.

These problems are common to any steam equipment manufacturer, regardless of design, but can be minimized by furnishing the boiler with treated water.

Other factors affecting steam generation are iron content, amount of chlorination and dissolved gases.

The desired water properties can best be achieved by using a **properly maintained water treatment system**.

The water level probes in the boiler use ions in the water to detect the water level. **Do not use fully demineralized or de-ionized water since it is non conductive and the water level can not be detected.**

The use of strainers will not remove minerals from the water.

Water supplies vary from state to state and from locations within a state. Therefore, a **water treatment specialist should be consulted** before the installation of any steam generating equipment.

Steamers that operate over a long period of time without the benefit of a water treatment system, which have developed a heavy scale build-up, should be cleaned before using the system.

**SPECIFICATIONS**

**Boiler Pressure**

Operating - 10 to 12 psi

Maximum - 15 psi

**Water Supply**

The fact that a water supply is potable is no guarantee that it is suitable for steam generation. The supply connection to the steam generator should be treated water and must be within the guidelines listed below. For drain water cooling only, an untreated water supply connection should be used.

Supply connection	cold water
Supply pressure should be	20-60 psig
Hardness*	less than 60 ppm
Silica	less than 13 ppm
Total Chloride	less than 4 ppm
PH Range	7 to 8
Un-dissolved Solids	less than 5 microns
*17.1 ppm = 1 grain of hardness	

**Electrical**

MODELS	TOTAL KW	AMPERAGE				
		1 PHASE		3 PHASE		
		208V	240V	208V	240V	480V
VHX24E,	24	116	100	67	58	29
VHX24E5,	36	---	---	100	87	44
MHB24E	42	---	---	117	---	---
	48	---	---	---	116	58

**NOTES:**

1. Amperage values in the table are nominal. Tolerance is +5/-10%.
2. Voltage values are @ 60HZ.
3. 24KW 3 phase is standard for both models. If a 24KW single phase connection is needed, the machine is field convertible at the terminal block. See heating element circuit diagram A11388.

**TOOLS**

**Standard**

- Standard set of hand tools.
- VOM with AC current tester.

**NOTE:** Any quality VOM with a sensitivity of at least 20,000 ohms per volt can be used.

**Special**

- The recommended deliming chemical for the water treatment system in use, for deliming of the boiler.
- Heat Exchanger Gasket (joint sealant strip, Teflon) P/N 854058-1.
- Loctite 242 thread sealant or equivalent P/N 520228. Used on the top and bottom cooking compartment door screws.
- 3/8 x 16 tap. Used for cleaning out threads on front boiler flange.

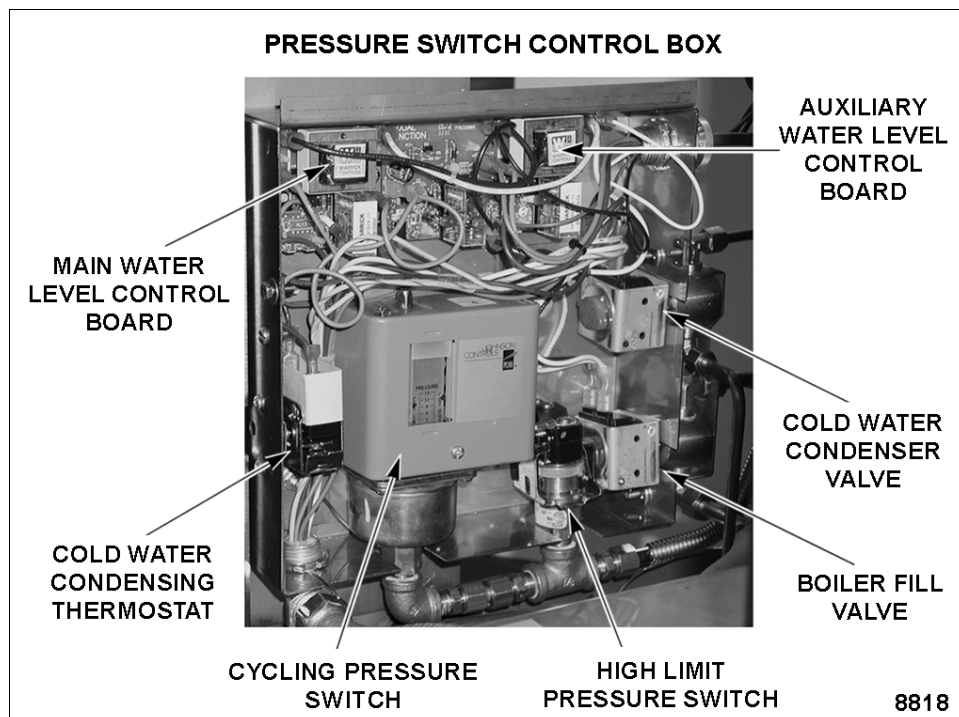
# REMOVAL AND REPLACEMENT OF PARTS

## PRESSURE SWITCH CONTROL BOX COMPONENTS

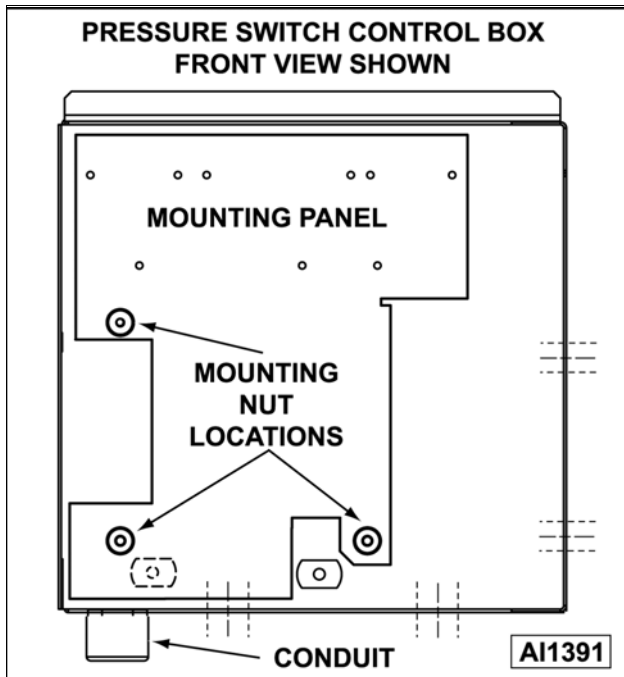


**WARNING:** DISCONNECT THE ELECTRICAL POWER TO THE MACHINE AND FOLLOW LOCKOUT / TAGOUT PROCEDURES.

**CAUTION:** Certain components in this system are subject to damage by electrostatic discharge during field repairs. A field service grounding kit is available to prevent damage. The field service grounding kit must be used anytime a control board is handled.



1. Open the cabinet base door.
2. Remove cover from pressure switch control box.
3. Disconnect lead wires from component being replaced.
4. To remove:
  - A. Cycling pressure switch.
    - 1) Disconnect compression fittings in the pressure supply line leading to the switch.
    - 2) Remove mounting nuts from pressure switch mounting panel.
    - 3) Disconnect conduit from box.



- 4) Disconnect lead wires from other components as necessary then remove pressure switch mounting panel.
- 5) Remove screws securing switch to panel.

**B. High limit pressure switch.**

- 1) Disconnect compression fittings from switch then remove from box.

**C. Boiler fill or cold water condenser valve.**

- 1) Turn water supply off and disconnect compression fittings from valve.
- 2) Remove valve bracket mounting screws.

**D. Main or auxiliary water level control board**

- 1) Compress locking tab on the board mounting standoffs and remove control board.

5. Reverse procedure to install.

**NOTE:** Before installing the cycling pressure switch, use pressure scale on the switch to preset the approximate cut-out (off) and cut-in (on) set points.

- A. Adjust the installed pressure switch (cycling or high limit) as outlined in SERVICE PROCEDURES AND ADJUSTMENTS.

6. Check for proper operation.

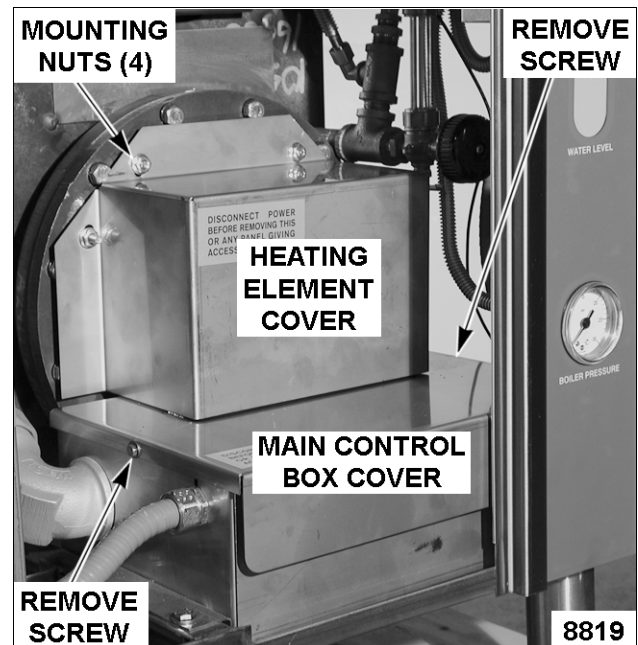
## MAIN CONTROL BOX COMPONENTS



**WARNING:** DISCONNECT THE ELECTRICAL POWER TO THE MACHINE AND FOLLOW LOCKOUT / TAGOUT PROCEDURES.

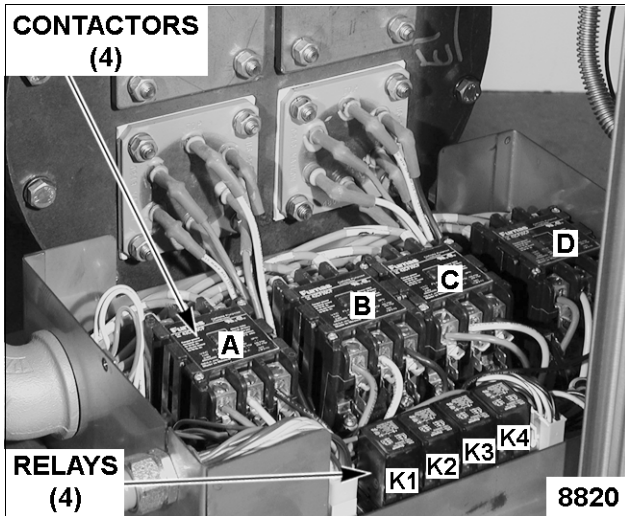
**CAUTION:** Certain components in this system are subject to damage by electrostatic discharge during field repairs. A field service grounding kit is available to prevent damage. The field service grounding kit must be used anytime a control board is handled.

1. Open the cabinet base door.
2. Remove heating element cover then main control box cover.



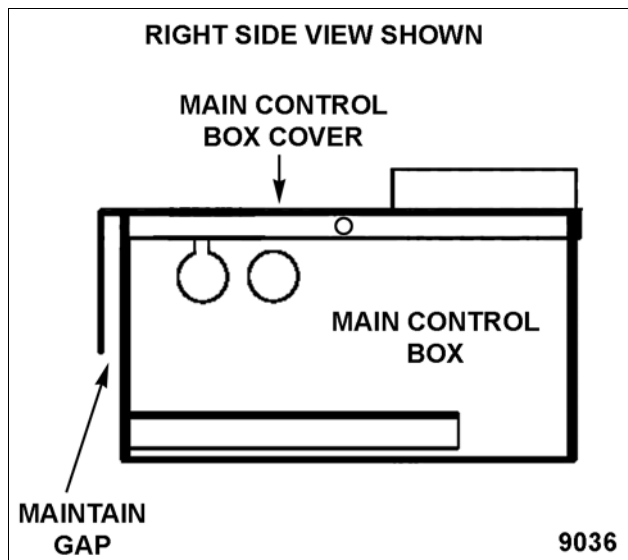
3. Disconnect lead wires from component being replaced.





4. To remove:
  - A. Contactors.
    - 1) Release catch at the base of contactor and remove from DIN rail.
  - B. Relays.
    - 1) Remove from socket.
  - C. Relay Board.
    - 1) Compress locking tab on the board mounting standoffs and remove control board.
5. Reverse procedure to install and check for proper operation.

**NOTE:** When the main control box cover is properly installed, the gap between the front lip of cover and main control box must be maintained for adequate ventilation. Do not seal the gap.

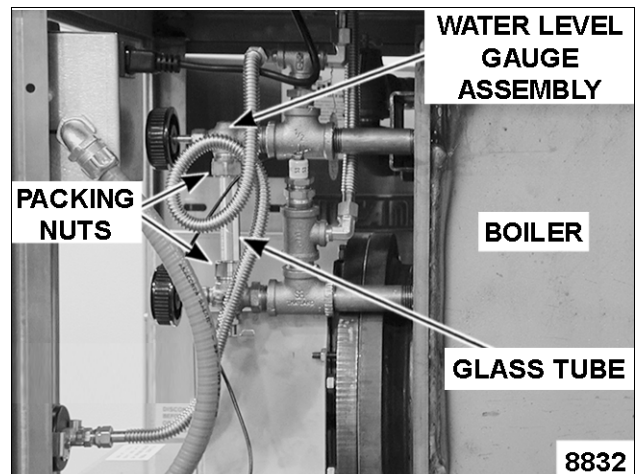


## WATER LEVEL GAUGE ASSEMBLY



**WARNING:** DISCONNECT THE ELECTRICAL POWER TO THE MACHINE AND FOLLOW LOCKOUT / TAGOUT PROCEDURES.

1. Remove right side panel.
- NOTE:** If right side panel is not accessible, open the cabinet door and remove control panel to access from front.
2. Loosen packing nuts on glass tube until threads disengage then slide nut toward center of tube.



**LEFT SIDE VIEW SHOWN**

3. Slide glass tube up until it clears the bottom fitting, tilt out at the bottom and slide glass tube down to remove.

**NOTE:** Clean glass tube if cloudy or replace if chips or cracks are noticed.

4. Remove packing nuts from glass tube.
  - A. A single rubber washer is installed inside each packing nut. Clean debris from washer and inspect the rubber for cracks or hardening.
    - 1) If rubber washer needs replacing, install a replacement rubber washer in each packing nut.

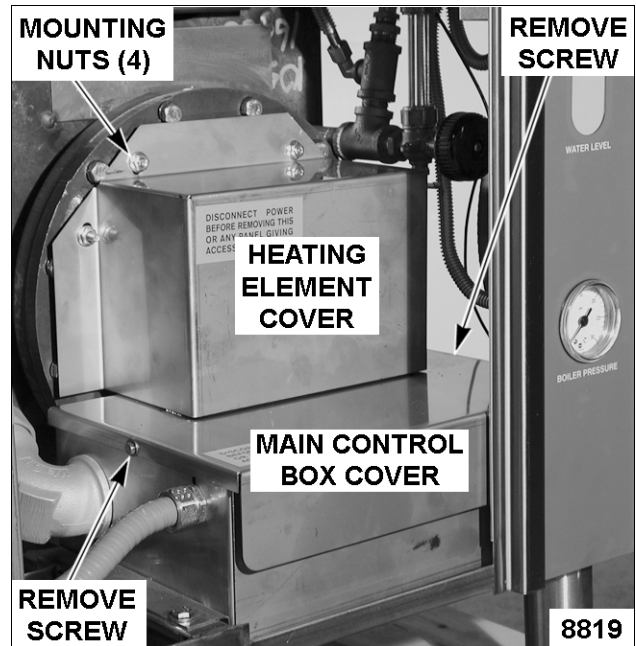
**NOTE:** When installing, ensure friction washer (flat) is installed inside the packing nut before rubber washer.

5. To Install:
  - A. Slide packing nuts onto glass tube and position each nut approximately 1" from open end on tube.

- B. Insert one end of glass tube into top gauge fitting then align opposite end of tube with bottom gauge fitting.
- C. Lower the glass tube into bottom gauge fitting then center the tube between top & bottom gauge fittings.
- D. Hold glass tube in place and hand tighten the bottom packing nut then top.
- E. Tighten each packing nut and additional 1/2 turn.

**CAUTION: Do not over tighten packing nuts or damage to glass tube may occur.**

6. Re-connect power to the machine.
7. Turn power switch on and allow boiler to fill.
  - A. Press reset switch to begin heating (green ready light on).
8. Check gauge glass for water and steam leaks.
  - A. If necessary, slowly tighten packing nuts until leak stops.
9. Install right side panel or front control panel (if removed).



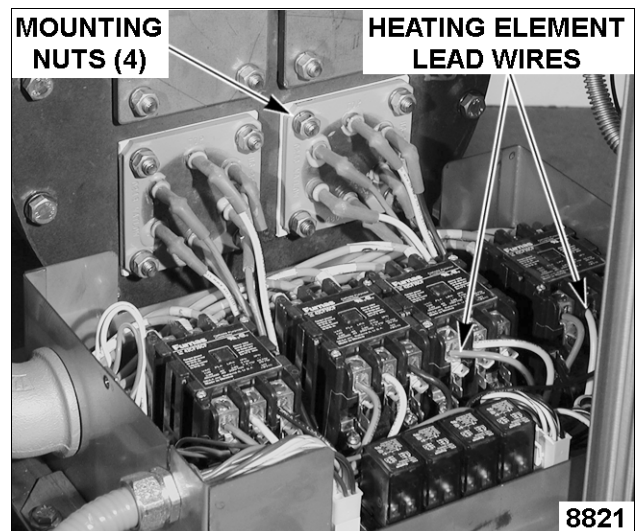
4. Disconnect lead wires from heating element at the contactor terminals.
5. Remove mounting nuts from heating element and remove the element from boiler.

## HEATING ELEMENTS



**WARNING: DISCONNECT THE ELECTRICAL POWER TO THE MACHINE AND FOLLOW LOCKOUT / TAGOUT PROCEDURES.**

1. Turn power switch off and allow boiler to blowdown/drain.
2. Open the cabinet base door.
3. Remove heating element cover then main control box cover.



6. Clean the mating surface on mounting plate then install a replacement gasket and heating element.
7. Reverse procedure to install and check for proper operation.

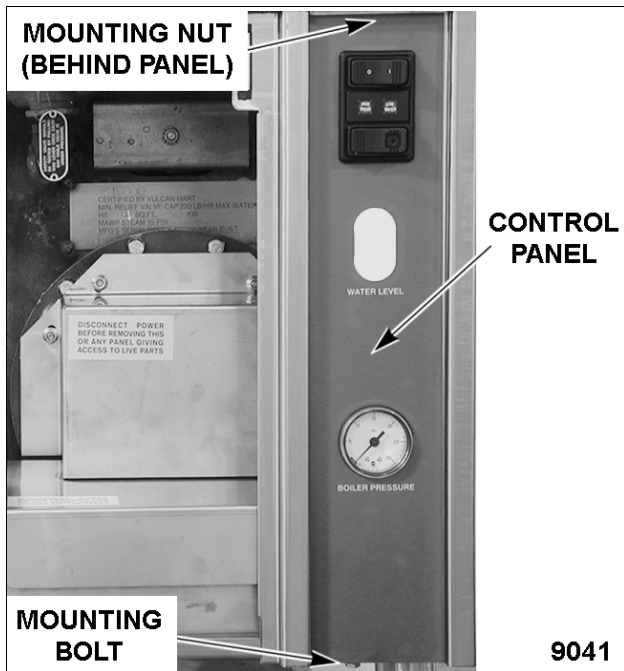
**NOTE:** When installing heating element, route the lead wires between the contactors.

## HEATING ELEMENT MOUNTING PLATE

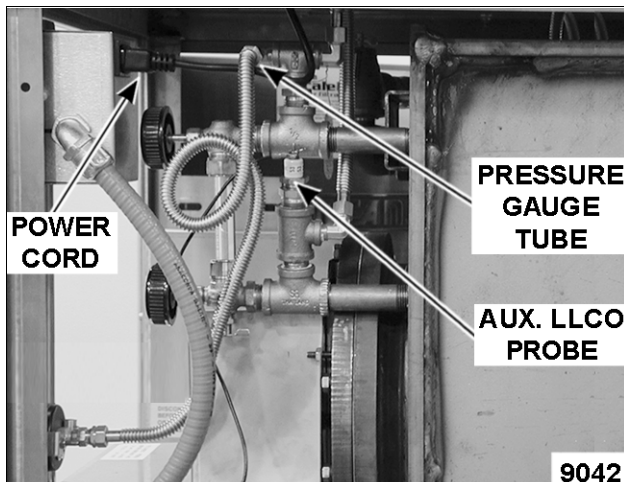


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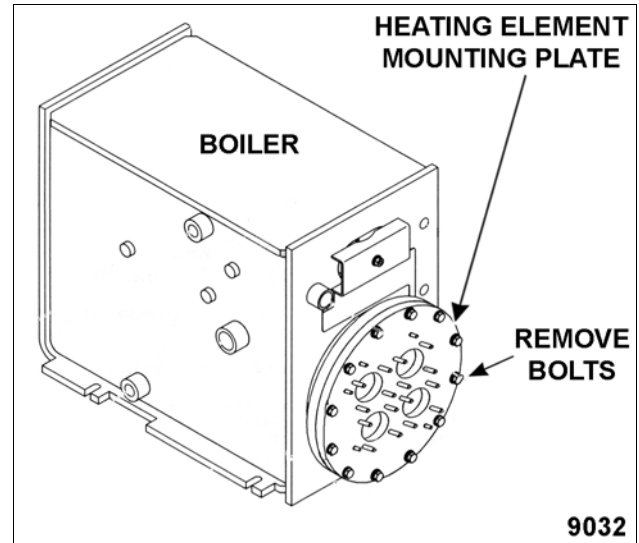
1. Remove heating elements as outlined under HEATING ELEMENTS.
2. Loosen mounting hardware securing control panel to frame and lower the panel.



3. On models with cooking compartments only, disconnect power cord from power switch box (rear of control panel).
4. Disconnect pressure gauge tube from fitting at tee.
5. Disconnect lead wire from Aux LLCO probe.



6. Loosen both conduit locking nuts (1 1/2" & 3/8") in main control box.
7. Loosen conduit nut (1 1/2") on elbow connected to main control box.
8. Remove mounting bolts for main control box.
  - A. Lift main control box to remove from the frame and position it to the left side.
9. Remove heating element mounting plate.



10. To install:
  - A. Clean the mating surfaces on heating element mounting plate and boiler.
  - B. Install new gasket on boiler side of mounting flange.



- C. Position heating element mounting plate with mounting studs for the element cover at the top.

**NOTE:** When installing heating element mounting plate, install and tighten the mounting bolts as indicated to ensure the mounting plate is flush with boiler flange and gasket is evenly compressed. If bolt is not threading properly by hand, clean out the threads with a 3/8 x 16 tap.

- D. Align mounting holes then press and hold heating element mounting plate against the gasket. Install two bolts at the top and two bolts at the bottom. **Hand Tighten Only.**
- E. Starting with the bottom bolts, tighten each bolt a few turns at a time and alternate between the bottom and top bolts.
- F. Install two bolts at the left and two bolts at the right on the heating element mounting plate. Tighten each bolt a few turns at a time and alternate between the left and right bolts.
- G. Install the four remaining bolts. Tighten each bolt a few turns at a time and alternate between the four remaining bolts.

11. To complete heating element mounting plate installation, reverse procedure from main control box removal.

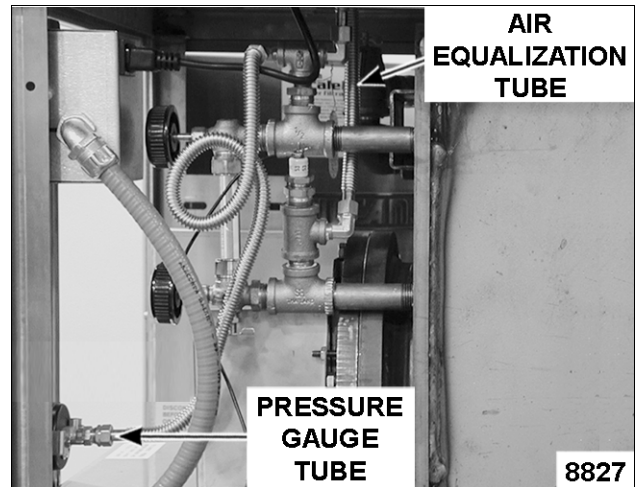
## BOILER ASSEMBLY



**WARNING:** DISCONNECT THE ELECTRICAL POWER TO THE MACHINE AND FOLLOW LOCKOUT / TAGOUT PROCEDURES.

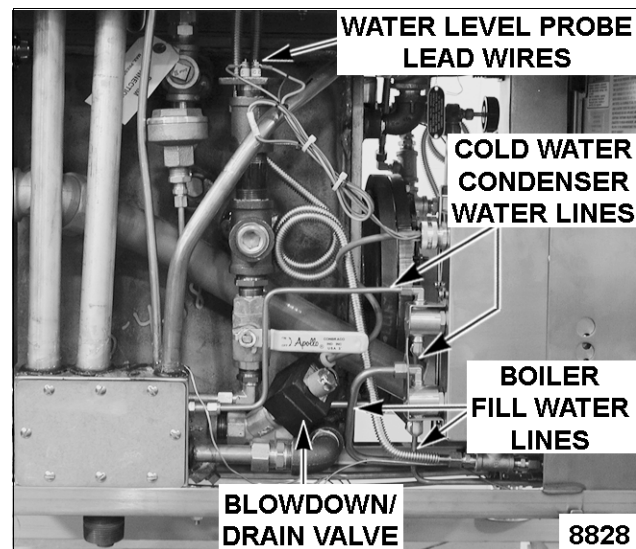
**NOTE:** To perform this procedure, the steamer must be accessible from all sides.

1. Turn power switch off and allow boiler to blowdown/drain.
2. Turn water supply off.
3. Remove left and right side panels.
4. Raise steamer from the bottom right side by approximately three inches to drain the remaining water from boiler. Lower steamer when boiler is empty.
5. Remove heating element mounting plate as outlined under HEATING ELEMENT MOUNTING PLATE.
6. Disconnect pressure gauge tube from gauge.
7. Disconnect air equalization tube and remove.



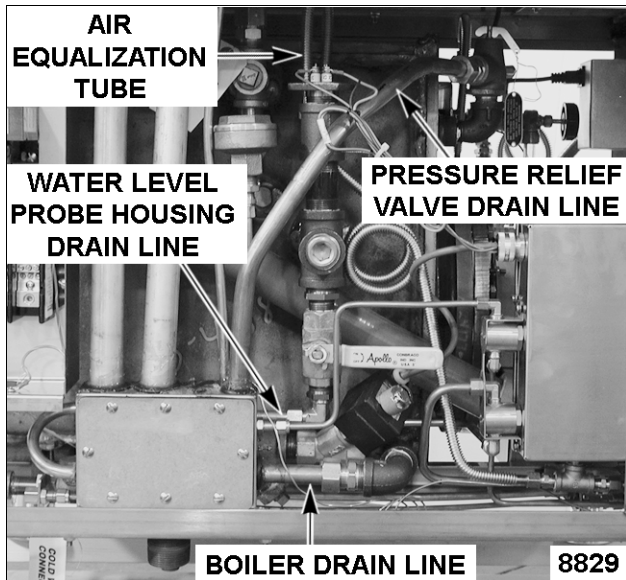
RIGHT SIDE VIEW SHOWN

8. Remove gauge glass as outlined under WATER LEVEL GAUGE ASSEMBLY.
9. Disconnect water level probe lead wires.
10. Remove coil from blowdown/drain valve.
11. Disconnect boiler fill and cold water condenser valve water lines and remove lines.

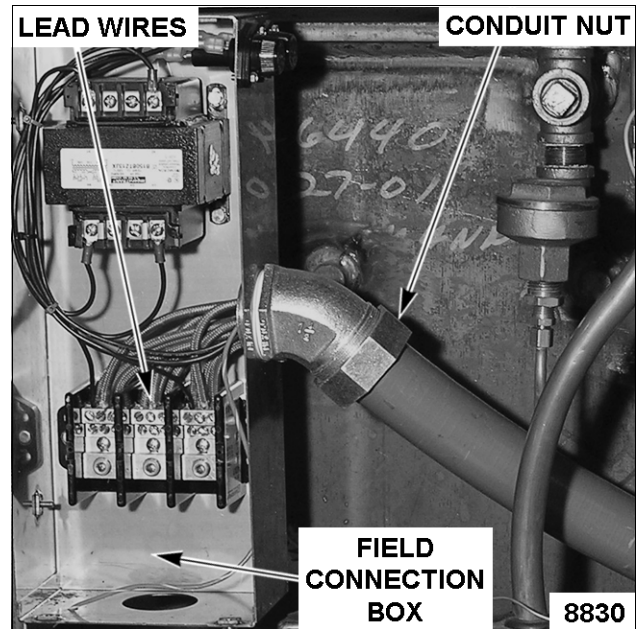


LEFT SIDE VIEW SHOWN

12. Remove cover from pressure switch control box and loosen conduit locking nut.
13. Remove mounting screws for pressure switch control box.
14. Disconnect pressure relief valve drain line at the valve.
15. Disconnect water level probe housing air equalization tube and remove tube.
16. Disconnect water level probe housing drain line from condenser drain box.
17. Disconnect boiler drain line from condenser drain box.



LEFT SIDE VIEW SHOWN



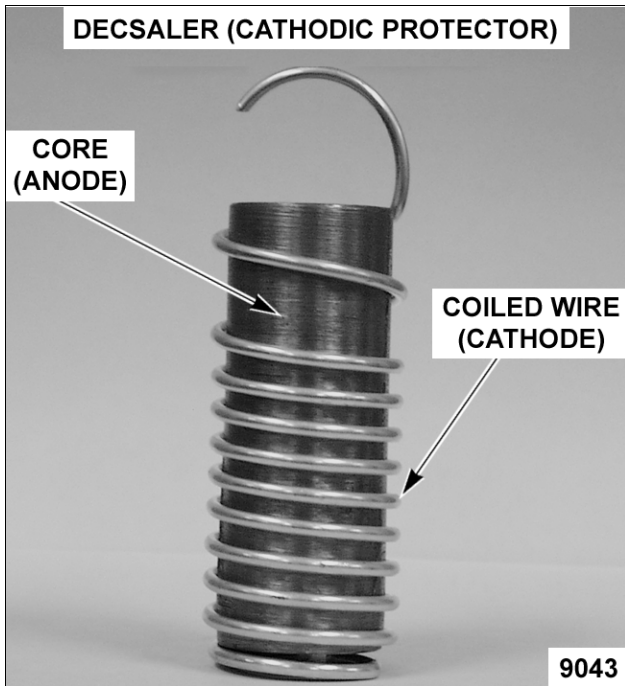
LEFT SIDE VIEW SHOWN

18. Separate union at boiler drain.
19. On models with cooking compartments:
  - A. Remove the left and right access panels between the cooking compartments and boiler base.
  - B. Disconnect flexible steam supply line from boiler tee to cooking compartments and remove the line.
  - C. Disconnect both drain lines from cooking compartments to condenser drain box and remove the lines.
20. On models with steam generator base only, disconnect steam supply line from boiler tee.
21. Loosen conduit nut on field connection box and slide nut down onto conduit.
22. Remove cover from field terminal box and disconnect lead wires from terminal block.
23. Remove main control box and pressure switch control box from boiler base.
24. Remove bolts securing boiler to base frame then slide boiler forward to remove.
25. Remove all plumbing components from boiler and install on replacement boiler.
26. Install replacement boiler but hand tighten mounting bolts only.
27. To complete boiler installation, reverse procedure from main control box and pressure switch control box removal.
28. When all connections to boiler are made, tighten boiler mounting bolts to secure boiler to base frame.
29. Check for proper operation.

### DESCALER (Cathodic Protector)

**NOTE:** The descalers are accessible only through the heating element mounting plate opening in boiler.

1. Remove heating element mounting plate as outlined under HEATING ELEMENT MOUNTING PLATE.
2. Remove the two descalers hanging from the front horizontal support rod.



3. To install:
  - A. On the two replacement descalers, stretch the coiled wire (cathode) at the top to elongate the wire then form an open loop.
  - B. Hang the descalers on the front horizontal support rod; one to the left of the heating elements and one to the right.
  - C. Position the descalers so the core (anode) is below the minimum water level in the boiler and hanging freely.

**NOTE:** To function properly, the descalers must not contact the interior surfaces of the boiler or the heating elements.

## COOKING COMPARTMENT DOOR(S)

### Removal

1. Remove top cover.
2. Open the door.
3. Pull hinge rod up.
4. Reverse the procedure to install, making sure the door bushings are in place.

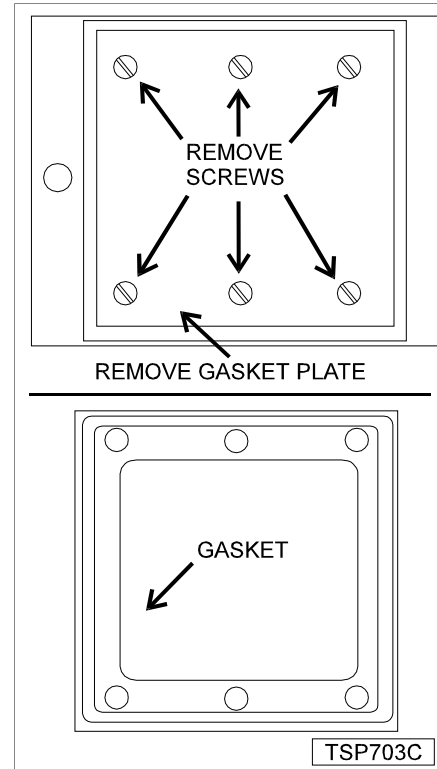
### Gasket

1. Open the door.
2. Remove screws from the gasket plate.
3. Pull the gasket plate out from the door housing and remove the gasket.
4. Position the new gasket on the gasket plate and reverse the procedure to install.

5. Adjust the door as outlined in DOOR SEALING ADJUSTMENT under COOKING COMPARTMENT.

**NOTE:** Do not over tighten gasket plate screws as this will compress the gasket excessively and interfere with proper door sealing.

**NOTE:** Damage to the gasket sealing surface, such as nicks or cuts, will cause steam leakage.



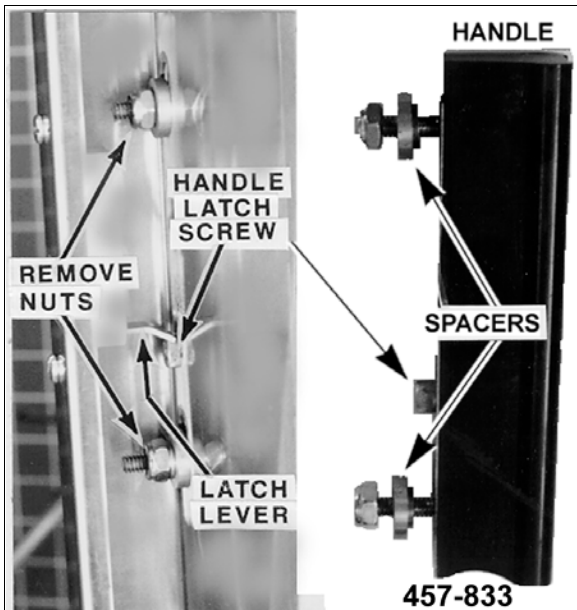
### Handle

1. Open the door.
2. Remove screws from the top and bottom of the door.
3. Pull the inner door panel out from the door housing with the gasket plate and gasket still attached.



- Remove the nuts and spacers from the handle screws and remove the handle from the door.

**NOTE:** When installing the spacers, the smaller diameter fits into the slot in the door and the latch lever must rest on top of the handle latch screw.



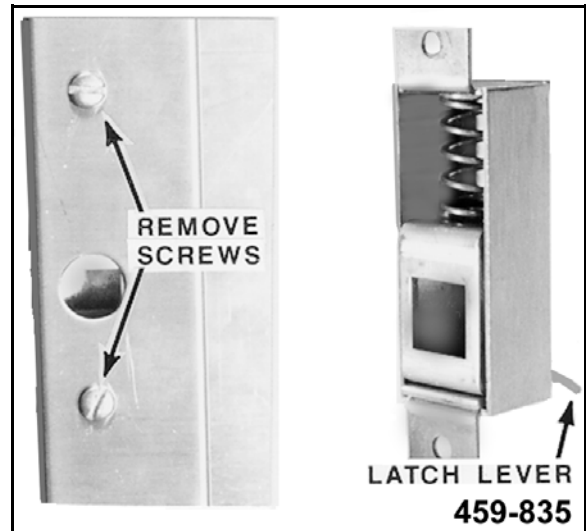
- Reverse procedure to install.

**NOTE:** When installing screws at the top and bottom of door, apply thread sealant.

#### Latch Assembly

- Open the door.
- Remove screws from the top and bottom of the door.

- Pull the inner door panel out from the door housing with the gasket plate and gasket still attached.
- Remove the screws from the side edge of the door that secure the latch mechanism and remove the latch from the door.



**NOTE:** When installing, the latch lever must rest on top of the handle latch screw.

- Reverse procedure to install.

**NOTE:** When installing screws at the top and bottom of door, apply thread sealant.

# SERVICE PROCEDURES AND ADJUSTMENTS

**WARNING:** CERTAIN PROCEDURES IN THIS SECTION REQUIRES ELECTRICAL TEST OR MEASUREMENTS WHILE POWER IS APPLIED TO THE MACHINE. EXERCISE EXTREME CAUTION AT ALL TIMES. IF TEST POINTS ARE NOT EASILY ACCESSIBLE, DISCONNECT POWER AND FOLLOW LOCKOUT / TAGOUT PROCEDURES, ATTACH TEST EQUIPMENT AND REAPPLY POWER TO TEST.

## BOILER

### Inspection

The boiler should be inspected for excessive lime scale build-up in a time frame dependant on the quality of the local water supply and steamer usage. In hard water areas or for steamers heavily used, a more frequent interval should be used. This inspection consists of an internal examination and cleaning of the boiler, an examination of the two hanging descalers (cathodic protectors) and for lime scale build-up on the water level probes. Also, check all boiler controls, including the pressure switches.

Periodic service must be performed as outlined in the BOILER procedures. See WATER CONDITIONING under GENERAL.

### Clean-Out

1. Turn power switch off and allow boiler to blowdown/drain.
2. Remove heating element mounting plate as outlined in REMOVAL AND REPLACEMENT OF PARTS.
3. Inspect descalers (cathodic protectors) as outlined under DESCALER (CATHODIC PROTECTOR) in this section.
4. Remove both descalers from boiler.
5. Clean interior of boiler using a wire brush or equivalent.
  - A. Dislodge and remove all loose scale from boiler. All loose debris must be removed from the boiler.
  - B. Remove all loose scale form the heating element mounting plate.
  - C. Clean the mating surfaces of the heating element mounting plate and boiler.
6. Check boiler drain and drain line plumbing for obstructions.
  - A. Remove cap and strainer screen from strainer body. Separate screen from cap and clean debris from screen.
  - B. Through the front opening in boiler, flush out the boiler and drain line plumbing with clean water.
7. Check probe housing and water level probes for scale build-up and clean as necessary.

8. Install descalers (cathodic protectors).
9. Install heating element mounting plate.
10. Install heating elements.
11. Check for proper operation.

### Deliming

Refer to the water filtration system manual supplied with steamer for specific instructions.

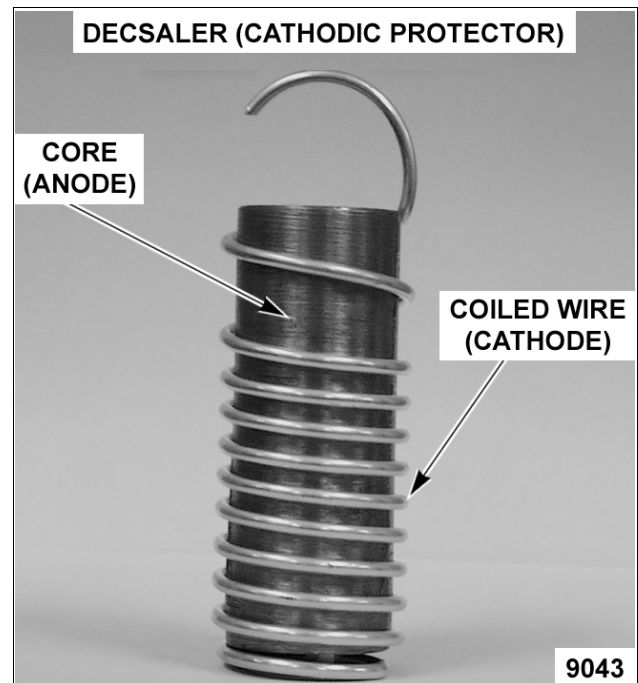
### Descaler (Cathodic Protector)

Two descalers are installed inside the boiler and are used as a preventative measure to:

- Reduce scale deposit build-up
- Help remove existing scale deposits
- Inhibit boiler and component corrosion

The descaler has a coiled wire (cathode) wrapped around a solid cylindrical core (anode) that hangs by an open loop from the front horizontal support rod inside the boiler.

The descaler materials serve as a sacrificial anode and cathode combination that chemically react with the contents of the boiler to meet the three objectives outlined above.





1. Access the descalers (cathodic protectors) as outlined in REMOVAL AND REPLACEMENT OF PARTS.
2. Inspect the two descalers hanging in boiler.

**NOTE:** As descalers erode over time, the diameter decreases while the length increases.

**NOTE:** A new descaler is approximately 1 3/8" diameter and 3 3/4" long at the core.

- A. If either descaler has increased to approximately 6" in length and the core is breaking apart (pieces falling off), both descalers should be replaced; or on an annual basis.

## WATER LEVEL PROBE HOUSING BLOWDOWN

The water level probe housing fills to the same water level in the boiler; and equalizes to the operating pressure in the boiler. When the manual ball valve on the probe housing assembly is opened, water and steam are blown thru this valve and should be visible exiting steamer drain. The probe housing blowdown should be performed in a time frame dependant on the quality of the local water supply and steamer usage. In hard water areas or for steamers heavily used, a more frequent interval should be used. The blowdown procedure is essential to proper operation and component life by removing sediment and scalants that may be lodged in the probe housing.

1. Turn power switch on and allow boiler to completely fill (approximately 1" of water visible in sight glass).
2. Press reset switch to begin heating and allow boiler to reach operating pressure.
3. Remove left side boiler base panel to access the manual ball valve.

**WARNING:** THE STEAMER AND ITS PARTS ARE HOT. USE CARE WHEN OPERATING, CLEANING OR SERVICING THE STEAMER. THE BOILER CONTAINS LIVE STEAM. STAY CLEAR WHEN OPENING THE VALVE.

4. Open the ball valve for approximately one minute while under pressure to thoroughly flush the probes and housing.
5. Close the ball valve and replace left side panel.
6. Press reset switch to resume heating and allow boiler to reach operating pressure.
7. Steamer is ready for use.

## WATER LEVEL CONTROLS TEST

A build-up of lime scale on or near the water level sensing probes may cause them to retain moisture on the probe surface and can give a false reading. Also, a cracked or damaged insulator may give a false reading.

These conditions may cause one or more of the following to occur:

- Boiler no heat
- Boiler no fill
- Boiler overflow
- Boiler no fill and dry fire

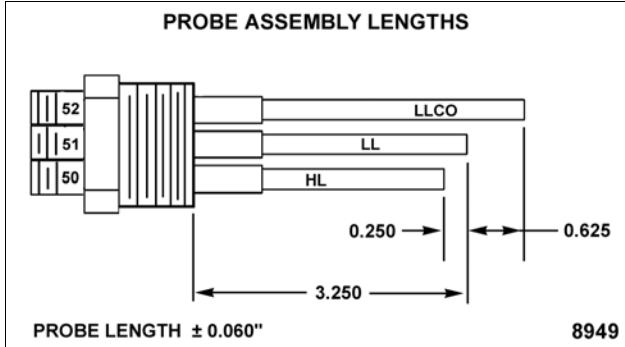
**NOTE:** Dry firing may cause damage to heating elements or boiler. If this condition is suspected, the affected components should be inspected.

### Main Water Level Control

**NOTE:** The main water level control is a dual functioning control that provides low level cut-off protection and differential water level control

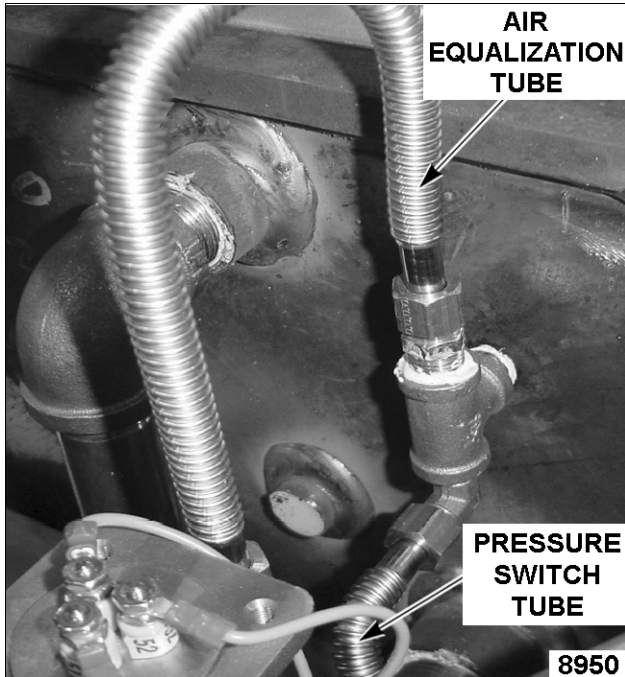
1. Turn power switch on and verify:
  - A. Low water light is lit (front control panel).
  - B. HL LED is lit on the water level control board.
  - C. Boiler is filling with water.
  - D. If boiler isn't filling with water:
    - 1) Verify 120VAC to boiler fill valve.
    - 2) Verify water supply is on and boiler fill valve isn't clogged.
2. At the end of the initial fill:
  - A. Verify approximately 1" of water visible in sight glass.
  - B. Verify green ready light is lit (front control panel).
  - C. Verify HL LED is not lit and LLCO LED is lit on the water level control board.
3. Open the ball valve on probe housing assembly (boiler left side) about half way. This will allow boiler water to drain slowly and activate a fill cycle. **Do not press the reset switch to start heating.** The next step requires a visual sight glass measurement that cannot be obtained if there is boiling action in the vessel.
  - A. Verify water level in sight glass drops 1/4" to 3/8" before a fill cycle is initiated. Repeat at least twice to verify correct fill.
  - B. If proper fill wasn't obtained:

- 1) Verify wire color connections are correct at probe numbers 50, 51 & 52, and at the water level control board.
- 2) Turn power switch off.
- 3) Remove probe assembly, clean lime scale build-up from the probes and compare probe lengths to drawing.



- 4) Disconnect 3/8" flexible line (air equalization tube) from probe housing assembly and from boiler tee. Check flex line for obstructions and remove as necessary.
- 5) Disconnect 3/8" flexible line (pressure switch tube) from boiler tee. Remove boiler tee and check for obstructions in the tee and in the mounting hole. Remove obstructions as necessary.

**NOTE:** When replacing, boiler tee **must** be mounted vertical to prevent a blockage due to condensate build-up.

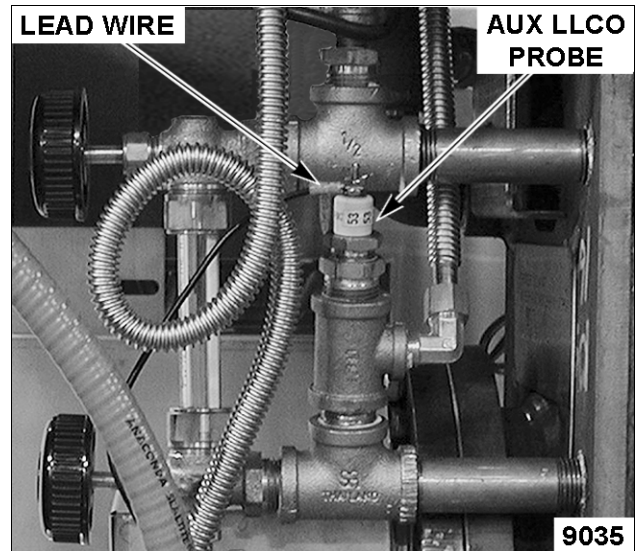


4. Test LLCO circuit on water level control board.

- A. Turn power switch on and allow boiler to fill. **Do not press the reset switch to start heating.**
- B. Turn water supply off and open the ball valve on probe housing assembly. This will allow boiler water to drain.
- C. When water level is no longer visible in sight glass and is below LLCO probe; LLCO LED should turn off, LLCO relay should de-energize and return LLCO relay contacts to their shelf state.
- D. Repeat at least twice to verify correct LLCO operation.

**Auxiliary Low level Cut-Off Control**

5. Turn power switch off.
6. Disconnect lead wire from Aux LLCO probe.



- A. Set VOM to read resistance (ohms) and connect meter leads to Aux LLCO probe and boiler. If there is any measurable resistance, remove and clean the Aux LLCO probe.
- B. Replace the probe and check resistance again. If resistance is still present, install a replacement probe.
- C. Verify resistance measurement with new probe installed.
7. Turn power switch on and allow boiler to begin filling. **Do not press the reset switch to start heating.**
8. With water below the lowest visible level in sight glass (below Aux LLCO probe) and boiler in initial fill state:
  - A. Verify Aux LLCO LED is not lit on the Aux water level control board.

- B. Verify Low Water light is lit (front control panel).
  - C. Verify 120VAC is on Aux LLCO COM, and 0 volt is on Aux LLCO N.O. contacts.
9. When water level reaches Aux LLCO probe as boiler continues to fill:
- A. Verify Aux LLCO LED is lit on the auxiliary low water board.
  - B. Verify the green ready light is lit (front control panel).
  - C. Verify 120VAC is on the Aux LLCO common and normally open contacts of the auxiliary water level control board.
10. Open the ball valve on probe housing assembly. This will allow boiler to drain.
11. When water level is no longer visible in sight glass and is below LLCO probe; Aux LLCO circuit should activate.
- A. Low water light turns on (front control panel).
  - B. Aux LLCO led turns off on the auxiliary low water board.
  - C. Press reset switch to verify lockout condition. Low water light should remain on.
  - D. **If lockout condition does not occur, immediately turn power switch off.**
    - 1) Disconnect power to machine.
    - 2) Replace auxiliary low level cut-off control and check for proper operation.
  - E. If lockout condition is ok, verify the auxiliary water level control circuit is functioning properly.
  - F. Close the ball valve on probe housing assembly and allow boiler to fill.
    - 1) Verify low water light turns off (front control panel).
    - 2) Press the reset switch and verify auxiliary contactors A & C are energized and boiler is heating.
3. Press reset switch and verify high pressure light turns off.
  4. When green ready light comes on, press reset switch to begin heating (low water light turns off).
    - A. Allow boiler to fully pressurize. Cycling pressure switch opens and heating stops.
  5. Turn one cooking compartment timer on to exhaust steam from boiler.
  6. Monitor boiler pressure gauge for two complete cycles. Note pressure at which the heat comes on and goes off.  
The heat should come on at 10 PSI and go off at 12 PSI.
    - A. If pressure readings differ, continue with procedure to adjust.
  7. Two pressure adjustment screws extend through the top of switch cover. A clockwise rotation increases pressure; a counter-clockwise rotation decreases pressure.
    - A. Turn the adjustment screw above right side pointer to obtain the proper cut-out (off) pressure setting.
    - B. Turn the adjustment screw above the left side pointer to obtain the proper cut-in (on) pressure setting.

**NOTE:** The screw directly above the right side pointer adjusts cut-out (off) and cut-in (on) set points without changing the differential. The screw directly above the left side pointer adjusts cut-in (on) set point and changes the differential.
  8. Monitor boiler pressure gauge for two complete cycles and note the pressure at which the heat comes on and goes off.
    - A. If pressures are correct, pressure switch is properly adjusted.
    - B. If pressures are not correct, repeat the adjustment for up to three attempts.
  9. If the above adjustment cannot be obtained, install a replacement pressure switch and adjust pressure settings as outlined in this procedure.

## CYCLING PRESSURE SWITCH ADJUSTMENT

1. Access cycling pressure switch as outlined under PRESSURE SWITCH CONTROL BOX COMPONENTS in REMOVAL AND REPLACEMENT OF PARTS.
2. Turn power switch on (boiler begins to fill).

## HIGH LIMIT PRESSURE SWITCH ADJUSTMENT

**NOTE:** Before the high limit pressure switch can be adjusted, the cycling pressure switch must be **temporarily** removed from the boiler control circuit. This allows the boiler to pressurize above the normal operating range. After the high limit pressure switch is properly adjusted, **the cycling pressure switch must be returned to its normal operating condition.** Follow the procedure as outlined in the steps below.

1. Access cycling pressure switch as outlined under PRESSURE SWITCH CONTROL BOX COMPONENTS in REMOVAL AND REPLACEMENT OF PARTS.
  - A. Remove cover from cycling pressure switch.
  - B. Connect a jumper wire between the two electrical terminals to **temporarily** remove the cycling pressure switch from the boiler control circuit.
2. Reconnect power to machine and turn power switch on (boiler begins to fill).
3. Press reset switch and verify high pressure light turns off.
4. When green ready light comes on, press reset switch to begin heating (low water light turns off).

**NOTE:** A pressure relief valve with a 15 PSI setting, serves as back-up to the high limit pressure switch.

5. Monitor boiler pressure gauge. Note pressure at which the high limit pressure switch opens (high pressure light turns on).

The switch should open at boiler pressures no less than 14.5 PSI but no greater than 15.0 PSI (MAX).

- A. If pressure reading differs, continue with procedure to adjust.

**CAUTION:** While making the adjustment, do not press on the wheel with extreme force. The switch may rotate and develop a leak at the compression fittings or in some cases, the rear lead wire may touch the control box and create an electrical short.

6. Turn adjustment wheel to change high limit pressure switch setting.
  - A. A counterclockwise rotation lowers the pressure switch set point; a clockwise rotation raises the pressure switch set point.

**NOTE:** For every click of the adjustment wheel, the pressure setting is changed approximately 1/8 PSI.

**NOTE:** Make the adjustment in small increments.

7. After adjusting high limit pressure switch, the boiler pressure must be reduced to check the pressure setting.
  - A. Remove left side boiler base panel to access the manual ball valve on the probe housing assembly.

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- B. Open the manual ball valve to release boiler pressure and monitor the boiler pressure gauge.

**NOTE:** High limit pressure switch resets at approximately 12 PSI (not adjustable).

- C. When pressure is reduced to approximately 8 PSI, close the ball valve.
- D. Press reset switch to reset the high pressure safety circuit and begin heating (high pressure light turns off).
8. Monitor boiler pressure gauge and note the pressure at which the high limit pressure switch opens.
  - A. If pressure is correct, the high limit pressure switch is properly adjusted.
  - B. If pressure is not correct, repeat the adjustment for up to three attempts.
9. If the above adjustment cannot be obtained, install a replacement high limit pressure switch and adjust as outlined in this procedure.
10. After the high limit pressure switch is properly adjusted, disconnect power to machine and allow boiler to blowdown/drain.
11. Remove jumper wire from cycling pressure switch to return the switch to its normal operating condition.
12. Check for proper operation.

## BOILER FILL AND COLD WATER CONDENSER SOLENOID VALVES

1. Access boiler fill and cold water solenoid valves as outlined under PRESSURE SWITCH CONTROL BOX COMPONENTS in REMOVAL AND REPLACEMENT OF PARTS.
2. Turn power switch on (boiler begins to fill).

3. To check boiler fill valve:
  - A. Verify 120VAC to solenoid valve coil.
  - B. If voltage is correct but valve is not opening (little or no water flow), turn power switch off and disconnect power to machine.
    - 1) Remove lead wires from coil and check for continuity.
    - 2) If no continuity is measured, install a replacement solenoid valve and check for proper operation.
    - 3) If continuity is measured, the coil is good.
  - C. If voltage is not correct, check main water level control board as outlined under WATER LEVEL CONTROLS TEST.

4. To check cold water condenser valve:

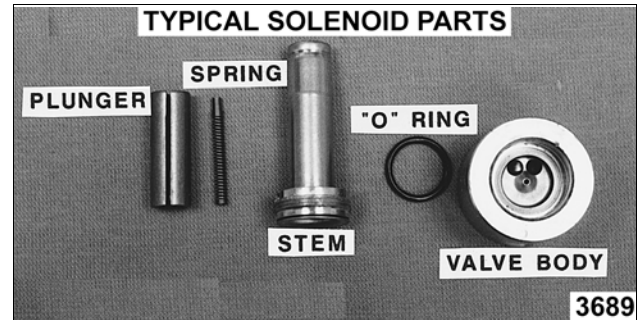
**NOTE:** Valve should energize only during cooking cycles and at boiler blowdown/drain.

- A. Verify 120VAC to solenoid valve coil.
- B. If voltage is correct but valve is not opening (little or no water flow), turn power switch off and disconnect power to machine.
  - 1) Remove lead wires from coil and check for continuity.
  - 2) If no continuity is measured, install a replacement solenoid valve and check for proper operation.
  - 3) If continuity is measured, the coil is good. Continue with procedure for additional valve checks.
- C. If voltage is not correct, check cold water condenser thermostat as outlined under COLD WATER CONDENSER THERMOSTAT ADJUSTMENT.

5. To check valve ports for clogs or valve component malfunction, continue with procedure for disassembly and inspection of internal components.
6. Turn water supply off, disconnect water line from valve body then remove solenoid valve.
7. Remove coil assembly from valve stem
8. Secure the valve body to keep it from turning.
9. Scribe a line on stem nut to valve body for proper re-tightening then remove stem locking nut and remove the stem from valve body.
10. All parts are now accessible for inspection and cleaning.

**NOTE:** If internal solenoid parts appear to be damaged or worn, then replace the solenoid valve. Do not reuse damaged or worn parts. **No internal solenoid parts are available as a service replacement.**

- A. Check rubber seal on bottom of plunger.
- B. Check plunger spring.
- C. Check O-ring in valve body.
- D. Check ports in valve body.



11. Reverse procedure to install and check for proper operation.

## COLD WATER CONDENSER THERMOSTAT ADJUSTMENT

During a cooking cycle or boiler blowdown/drain, the cold water condenser thermostat (N.O.) should close and energize the cold water condenser solenoid valve. The water from spray nozzle mixes with the drain water in the condenser drain box to reduce drain water temperature and condense steam vapors.

If excessive steam vapors are seen exiting the drain, adjust the cold water condenser thermostat as outlined below.

1. Turn power switch off and allow boiler to blowdown/drain.
2. Access cold water condenser thermostat as outlined under PRESSURE SWITCH CONTROL BOX COMPONENTS in REMOVAL AND REPLACEMENT OF PARTS.
3. Turn thermostat shaft fully counterclockwise to energize the cold water condenser solenoid valve.
  - A. Allow cold water to flow until condenser drain box has completely cooled.
  - B. Slowly turn thermostat shaft clockwise until thermostat opens and de-energizes the solenoid valve. Turn shaft an additional 1/4 turn to prevent the thermostat from closing near room ambient temperatures.
4. Check for proper operation.

## HEATING ELEMENT TEST

VOLTAGE	KW PER ELEMENT	AMPS PER ELEMENT	OHMS PER ELEMENT
208	9.0	14.4	14.4
240	9.0	12.5	19.2
480	9.0	6.3	76.8
208	10.5	16.9	12.4
208	12.0	19.3	10.8
240	12.0	16.7	14.4
480	12.0	8.3	57.6

- NOTES:**
1. Values in the table are nominal. Tolerance is +5/-10%.
  2. Voltage values are @ 60HZ.
  3. Resistance values (ohms) are @ room temperature. If heating elements are above room temperature, the measured resistance will be greater.
  4. Each heating element has 3 separate internal elements.

1. Access the heating elements as outlined in REMOVAL AND REPLACEMENT OF PARTS.
2. Measure voltage at heating element terminals and verify it against data plate voltage.
  - A. If voltage is incorrect, see TROUBLESHOOTING.
  - B. If voltage is correct, continue with procedure.
3. Check current draw (amps) through the heating element lead wires.

**NOTE:** Checking current draw is the preferred method over a resistance check when a clamp on type amp meter is available.

- A. If current draw is correct then heating element is functioning properly. See table for proper values.
  - B. If current draw is not correct, turn power switch off and disconnect the electrical supply.
    - 1) Install a replacement heating element.
  - C. If unable to check current draw, a resistance check may indicate a malfunctioning element.
    - 1) Turn power switch off and disconnect power to machine.
    - 2) Remove lead wires from heating element and check resistance (ohms). See table for proper values.
4. Check for proper operation.

## COOKING COMPARTMENT

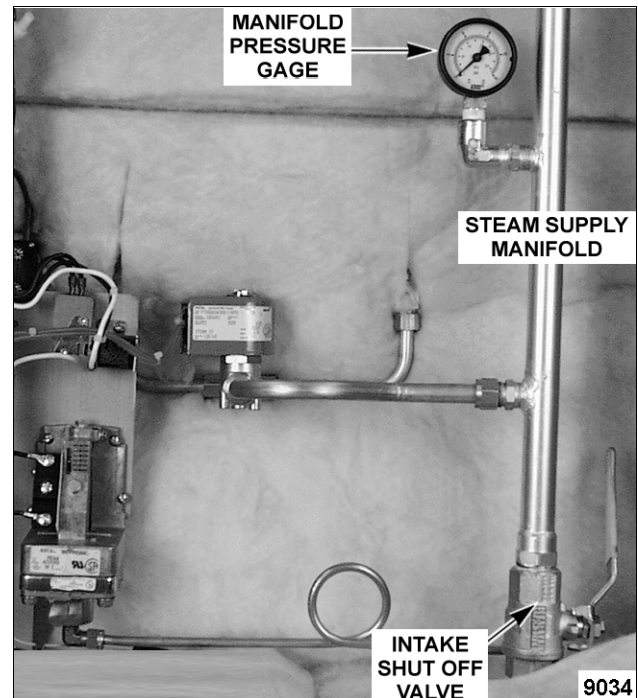
**NOTE:** Before proceeding with intake shut-off valve adjustment, monitor boiler pressure gauge and verify boiler is operating between 10-12 PSI. If boiler pressure adjustment is necessary, refer to CYCLING PRESSURE SWITCH ADJUSTMENT.

### Intake Shut-Off Valve Adjustment (Steam Flow)

1. Remove right side compartment panel.
2. Allow boiler to fully pressurize (heat turns off).

**NOTE:** The intake shut-off valve adjustment should be made while boiler pressure is at the upper cycling limit.

3. Turn both cooking compartment timers on.
4. Open the intake shut-off valve completely.
5. Slowly begin to close the intake shut-off valve and monitor manifold pressure gauge. Adjust the valve until manifold pressure gauge reading is between 8-10 PSI.



6. Monitor manifold pressure gauge reading for two complete boiler cycles.
  - A. If the manifold pressure gauge reading stays within tolerance while the boiler is cycling, the intake shut-off valve is set correctly.
  - B. If the manifold pressure gauge reading is outside of the tolerance repeat the adjustment.
7. Once the steam supply manifold pressure is set correctly, turn both cooking timers off and install right side compartment panel.

**Door Sealing Adjustment**

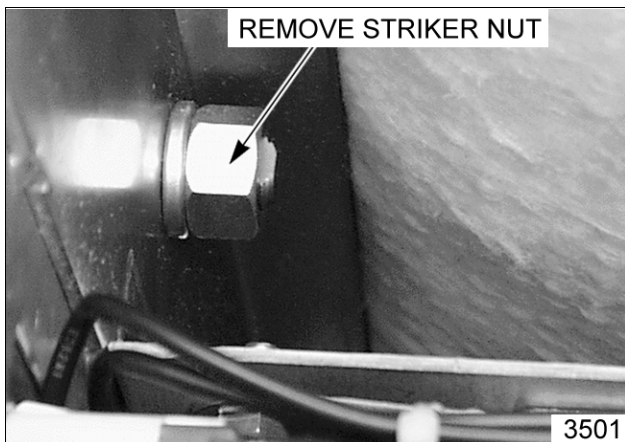
1. Check door gasket condition. If damaged or worn, replace as outlined under COOKING COMPARTMENT DOOR(S) in REMOVAL AND REPLACEMENT OF PARTS.
2. Loosen screws until the screw heads no longer touch gasket plate.
3. Tighten screws until the screw heads touch gasket plate and begin counting turns. Tighten all screws approximately two turns.
4. Close the door and check for proper operation.
  - A. If necessary, tighten all screws an additional 1/2 turn.
  - B. Repeat as necessary, tightening all screws by 1/2 turn until the door closes properly and no steam leaks are seen around gasket seal.

**Door Latch Adjustment**

Should cooking compartment door jam and cannot be opened, **do not force or pry** the door or damage may occur.

Lift bottom of door at the handle end to disengage latch. If door does not release, remove the right side panel to access door striker.

The door striker mounting nut is located behind the front panel of cooking cavity. Remove striker nut from striker to release door.



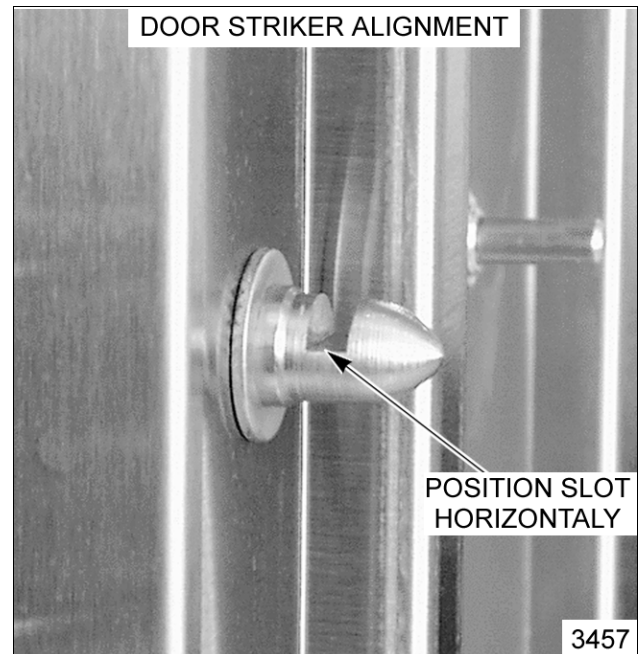
Remove any burrs on door striker that may cause door latch to stick. Reinstall door striker and adjust as outlined below.

**CAUTION: When installing, do not damage the slot in the door striker or door may not latch properly.**

To adjust:

1. Reinstall door striker with the slot pointing up and hand tighten striker nut only.
2. Close door to center the door striker in the oval mounting hole.

3. Open door and check the door strikers' slot for horizontal alignment. The slot on door striker must be kept horizontal for the door latch to catch on the door strikers' slot and latch.



4. Place a cloth over the door striker to protect the slot. Secure the door striker close to its base to keep it from turning and tighten striker nut.

**NOTE:** Do not over tighten as the striker will begin to turn and change alignment.

5. Check for proper operation.

# ELECTRICAL OPERATION

## COMPONENT FUNCTION

### CABINET BASE BOILER CONTROLS

- Power Switch** ..... Controls 120VAC to the boiler control circuit.
- Reset Switch (Manual)** ..... Resets the low water level safety circuit on initial startup or the occurrence of a low water condition. Also, resets the high pressure level safety circuit on initial startup or the occurrence of a high pressure condition which allows heating to start.
- Boiler Fill Valve** ..... Allows water flow to the boiler when energized thru HL-3 contacts on the water level control.
- Cold Water Condenser Valve** ..... Allows cold water to spray thru a nozzle inside the condenser drain box to condense steam and cool the hot water before discharging into the drain.
- Cold Water Condenser Cycling Thermostat** ..... Regulates cold water spray inside the condenser drain box during a cooking cycle or boiler blowdown/drain.
- Cycling Pressure Switch** ..... Regulates boiler pressure between cut-out (off) and cut-in (on) pressure settings of switch.
- High Limit Pressure Switch** ..... Prevents boiler from reaching pressures above 15 PSI by removing power from heating circuit. The high limit automatically resets at approximately 12 psi (green ready light on).
- Main Water Level Control** ..... A dual function control that allows water to fill and maintain the proper level in the boiler, providing differential level control; and removes power from heating circuit if water level drops too low, providing low level cut-off protection. The control uses three different probe lengths to monitor water level (high level HL, low level LL, low level cut-off LLCO).
- Auxiliary Water Level Control** ... A back up to the low level cut-off on the main water level control. Protects boiler and heating system components from a low water cut-off condition by opening the 120VAC voltage path to the heating circuit. The control uses a single probe to monitor water level (auxiliary low level cut-off Aux LLCO).
- Relay Board** ..... Provides a centralized location for wire harness connections and power transfer thru board relays (K1-K4) to the steamer controls. Also, provides voltage test points (T1-T7) for verifying voltage to relay coils, N.O. relay contacts closed, control panel lights and auxiliary contactor coils.

**NOTE:** The relay's below are mounted on the relay board and are individually replaceable.

- K1 Relay** ..... Energized when water level reaches the Aux LLCO probe (water level condition satisfied).
- K2 Relay** ..... Energized when high limit pressure switch is closed (high limit pressure condition satisfied). When K1 & K2 are energized, ready light (green) will be on.
- K3 Relay** ..... Energized when K1(2) N.O. contacts close and reset switch is activated. When K3 is energized, K3(2) N.O. contacts close and low water light turns off.
- K4 Relay** ..... Energized when K2(2) N.O. contacts are closed and reset switch is activated. When K4 is energized, K4(2) N.O. contacts close and high pressure light turns off. When K3 and K4 are energized, power is supplied to auxiliary contactors A & C.



- Supply Voltage Transformer** . . . . Provides 120VAC to the boiler control and cooking compartment control circuits.
- Cycling Contactors B & D** . . . . . Supplies line voltage to one side of heating elements thru cycling pressure switch N.C. contacts and LLCO-1 N.O. contacts.
- Auxiliary Contactors A & C** . . . . . Supplies line voltage to energize the heating elements thru relay K3 & K4 N.O. contacts.
- Heating Elements** . . . . . Heats water in boiler to generate steam.
- Blowdown/Drain Solenoid Valve** . . . . . N.O. valve that closes when energized by the power switch to allow boiler to fill and pressurize. When de-energized, valve opens to blowdown and drain the boiler contents.

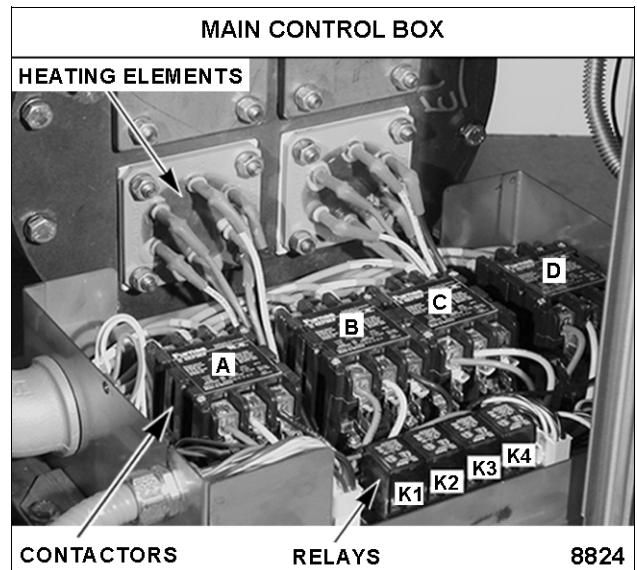
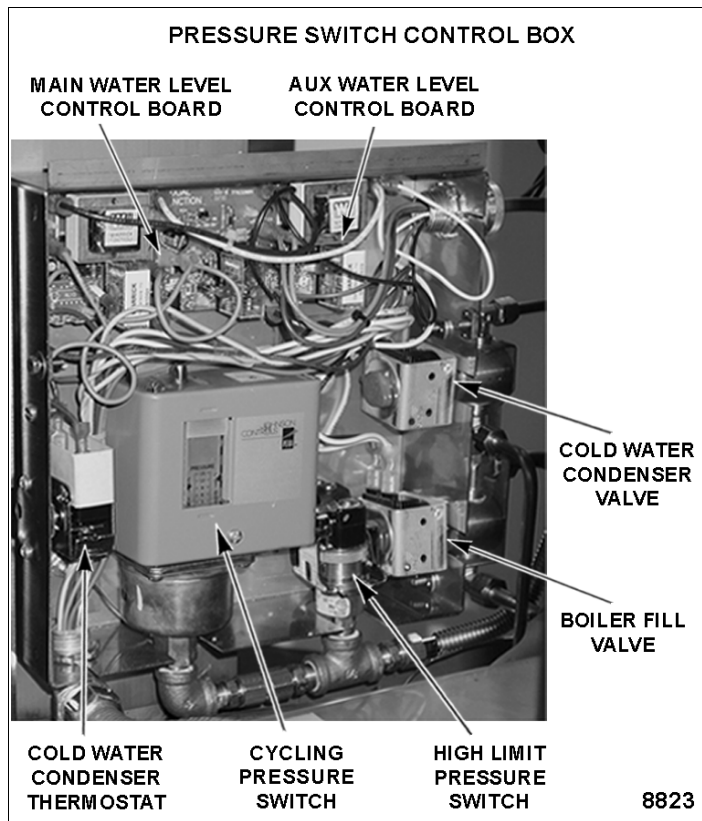
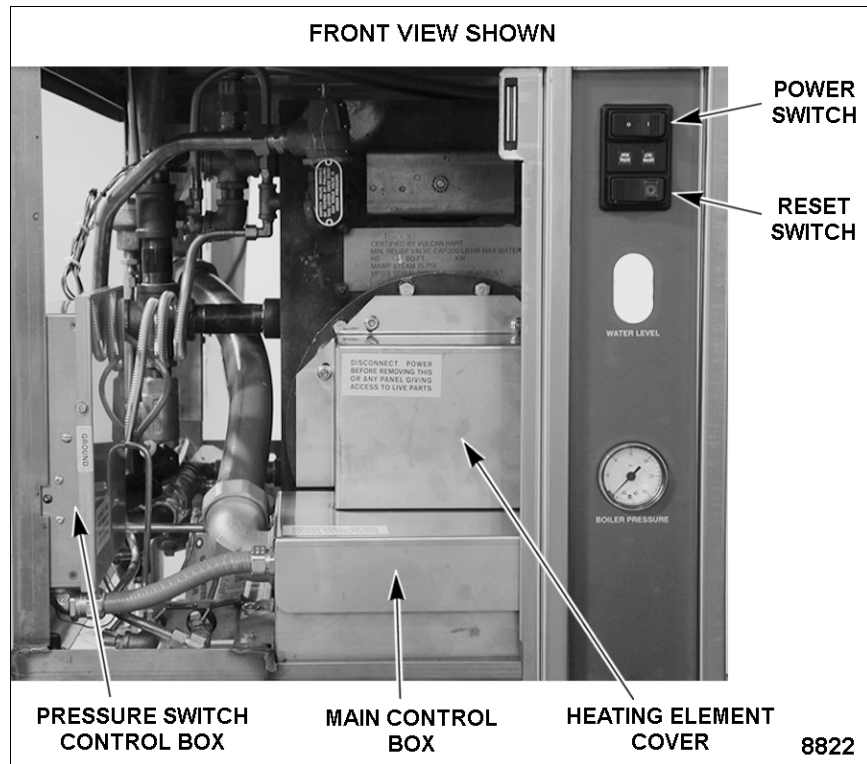
**COOKING COMPARTMENT CONTROLS**

The upper section of the steamer consists of two separate cooking compartments. Each compartment functions independently with its own set of controls. Power is supplied to the controls only after the steam pressure rises above the compartment pressure switch setting to close the N.O. contacts.

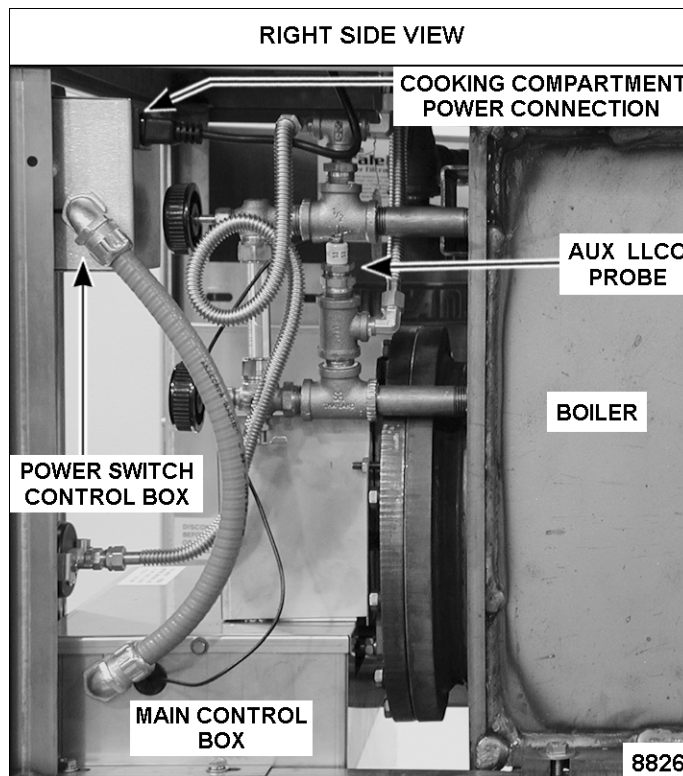
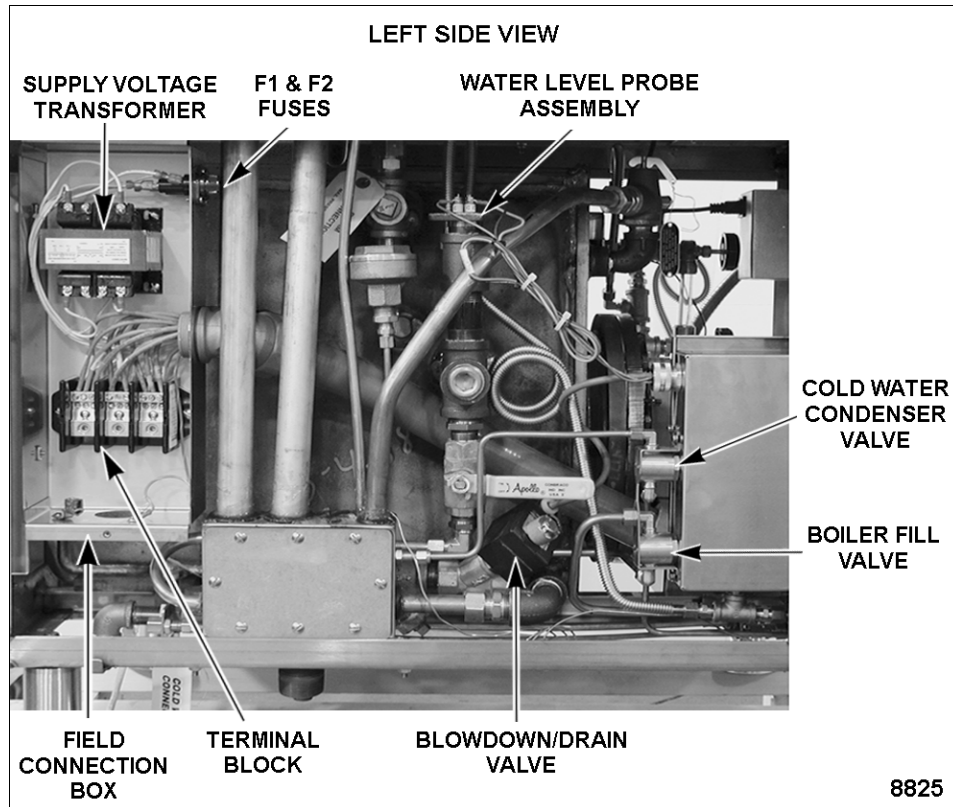
- Ready Light (Green)** . . . . . When lit, indicates steamer is ready to cook.
- Cooking Light (Red)** . . . . . When lit, indicates steamer is in a cooking cycle.
- Cooking Timer** . . . . . Use to set cooking time between 0-60 minutes. When timer is set, energizes the steam solenoid valve to allow steam into the cooking compartment. When time expires, energizes buzzer until turned off.
- Buzzer** . . . . . Signals end of a cook cycle, must be turned off manually.
- Door Switch** . . . . . Removes power to cooking timer. If time is dialed on cooking timer and compartments are steaming, removes power to steam solenoid valve when compartment door is opened.
- Steam Solenoid Valve** . . . . . When energized, opens to allow steam into the cooking compartment (normally closed valve).
- Compartment Pressure Switch** . . . . . Supplies power to cooking compartment controls, after steam pressure rises above approximately 3 psi to close the pressure switch. The pressure switch remains closed as long as steam pressure is above the stated pressure.

**COMPONENT LOCATIONS**

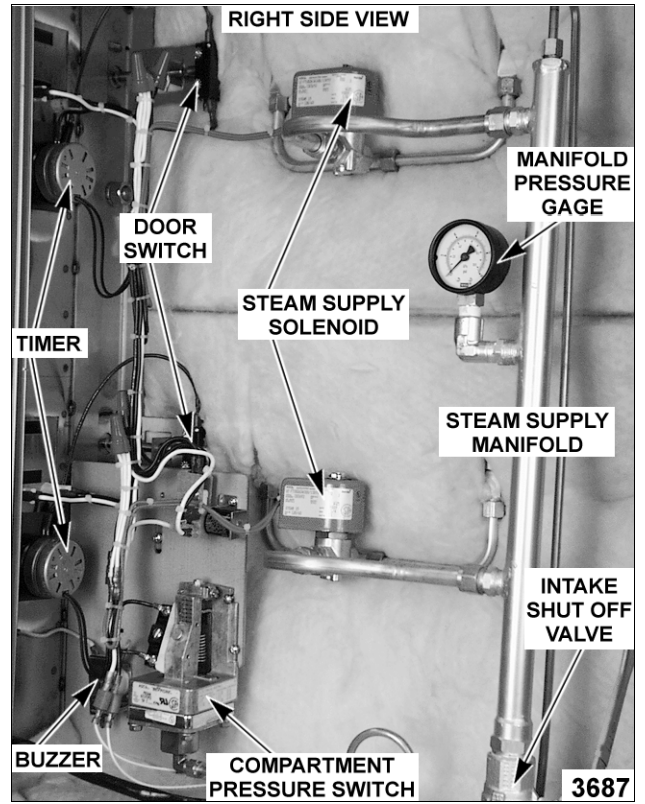
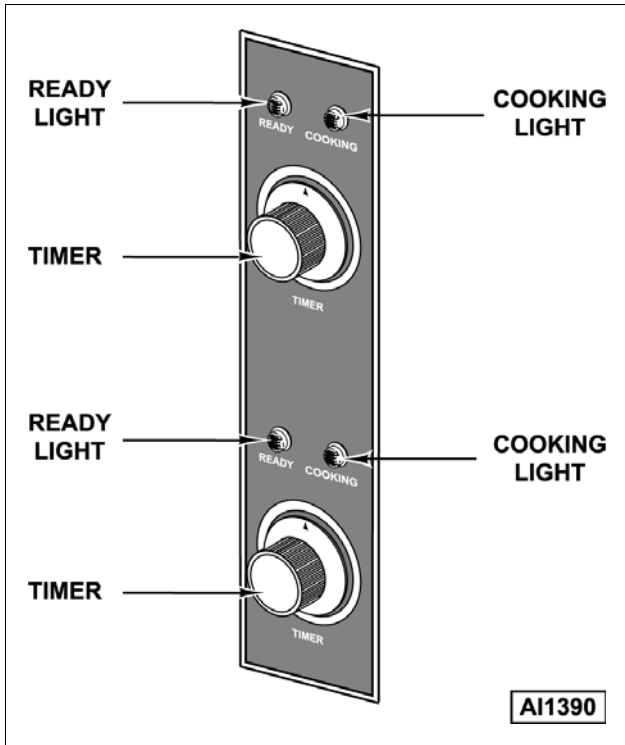
**Boiler Base Controls**



Boiler Base Controls Continued



Cooking Compartment Controls



## WATER LEVEL CONTROLS

### Low Level Cut-Off & Differential Control

The steamer is equipped with three water level sensing probes (high, low and low level cut-off) and a water level control board. The water level control board performs two functions: 1) Provide low level cut-off protection to shut off the heat source in case the water level drops below the low level cut-off (LLCO) probe. 2) Perform as a differential level control to maintain the water level between the low and high water level probes.

The water level control (WLC) board has input voltage (120VAC) across terminals 11 and 12 which powers the primary side of the transformer. On one side of the transformer secondary, power is provided to the control by a series path through chassis ground (terminal 10). The other side of the transformer secondary (12VAC) is attached to the probe that directs power to the other side of WLC board relay coils (LLCO and HL) and to the inverse latching relay (ILR) electronic circuit on the WLC board. As water enters the boiler, it becomes part of the WLC board circuit. When the water level in the boiler reaches a probe, that circuit is completed.

The inverse latching relay of the WLC board is de-energized, leaving the ILR-1 (N.O.) and ILR-2 (N.C.) contacts in their shelf state.

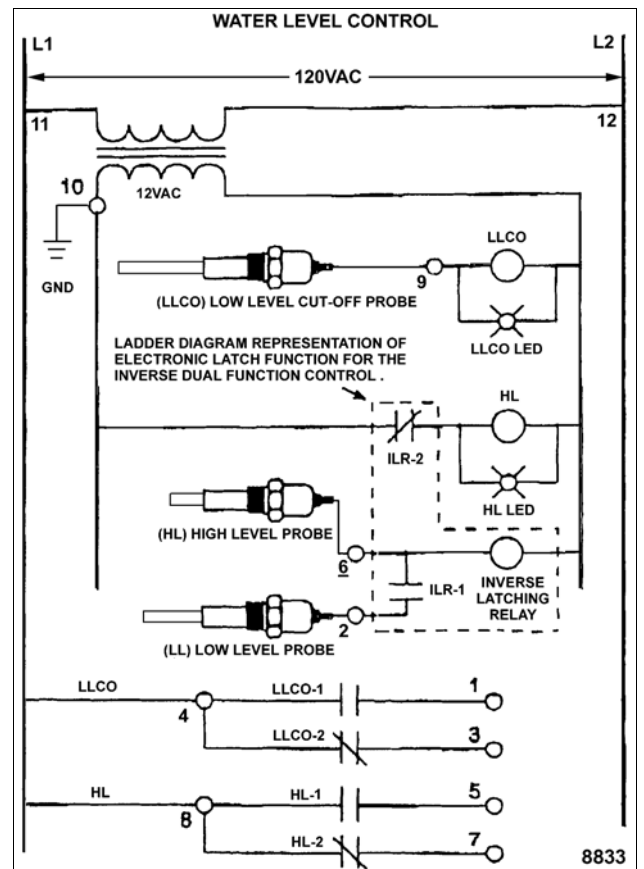
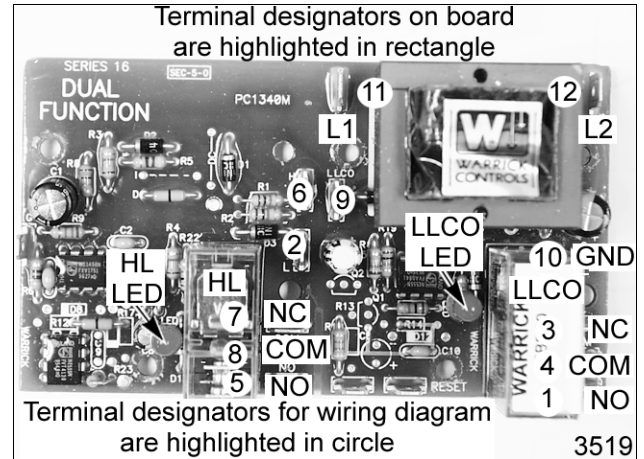
When the main power switch is turned on, power is supplied to the WLC board which energizes the high level (HL) relay, closes HL-1 normally open contacts, and illuminates the HL relay LED. With the HL-1 contacts closed, the boiler fill solenoid is energized and water begins filling the boiler.

When the water level reaches the low level cut-off (LLCO) probe, the LLCO relay is energized and illuminates the LLCO LED. With the LLCO-1 contacts closed, the heat source can be energized provided the auxiliary control(s) in the heating circuit are satisfied. The LLCO relay will remain energized and its LED will stay lit until the water level in the boiler drops below the LLCO probe.

When the water level reaches the low level (LL) probe, power to terminal 2 on the WLC board is present but no switching occurs.

After the water level reaches the high level (HL) probe, the inverse latching relay of the WLC board is energized and locked through the low level probe (LL) and ILR-1 contacts. With ILR-2 contacts open, HL relay is de-energized and the HL LED goes out. With the HL-1 contacts open, the boiler fill solenoid is de-energized, stopping the flow of water into the boiler.

When the water level drops below the low level (LL) probe, power is removed from the inverse latching relay, the HL relay energizes through ILR-2 and HL contacts change state. The boiler fill solenoid is energized through HL-1 to refill the boiler and the HL LED is lit. The HL relay and LED will toggle on and off during a cooking cycle as needed.



**Auxiliary Low Level Cut-Off**

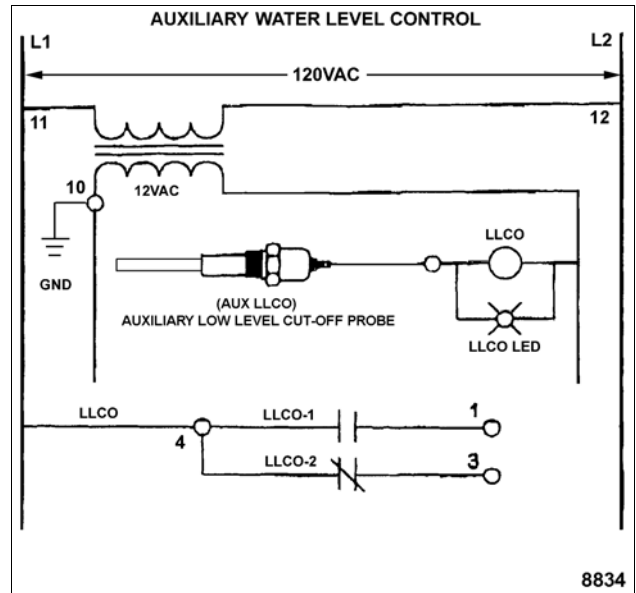
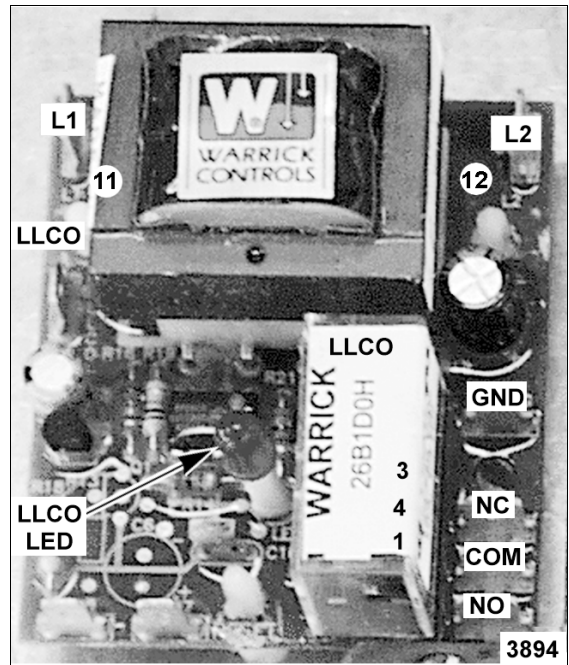
This control serves as a safety backup to the main water level control (WLC) board to meet CSD-1 code requirements. The operation of the auxiliary control board is identical to the low level cut-off (LLCO) function of the main WLC board but performs a single function: 1) Provide auxiliary low level cut-off protection to shut off the heat source in case the water level drops below the auxiliary low level cut-off (Aux LLCO) probe. A single Aux LLCO probe, identical to the LLCO probe on the main WLC board, is connected to the auxiliary control.

The auxiliary control board has input voltage (120VAC) across terminals 11 and 12 which powers the primary side of the transformer. On one side of the transformer secondary, power is provided to the control by a series path through chassis ground (terminal 10). The other side of the transformer secondary (12VAC) is attached to the Aux LLCO probe that directs power to the other side of the auxiliary control board relay (LLCO). As water enters the boiler, it becomes part of the auxiliary water level control's circuit. When the water level in the boiler reaches the Aux LLCO probe, the circuit is completed.

When the main power switch is turned on, power is supplied to the auxiliary control board but no switching occurs. Also, the low water level indicator light (amber) on the boiler base control panel comes on.

When the water level reaches the auxiliary low level cut-off (Aux LLCO) probe, the LLCO relay is energized (LLCO-1 close) and the LLCO LED lights up. The LLCO relay will remain energized and its LED will stay lit until the water level in the boiler drops below the Aux LLCO probe.

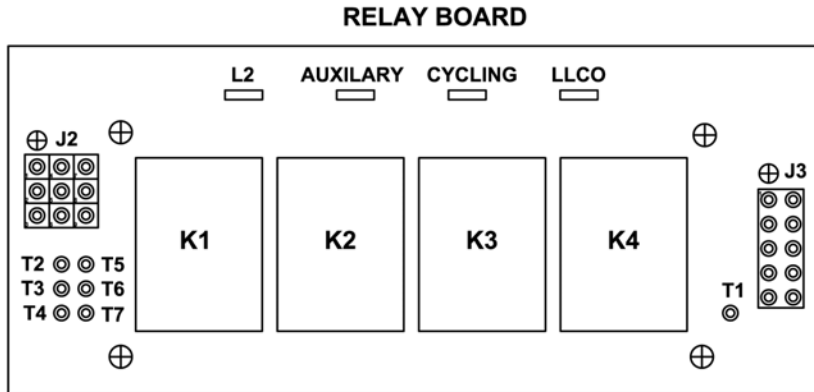
When the boiler stops filling, press the manual reset switch on the boiler base control panel. This turns off the low water light and energizes the heat source.



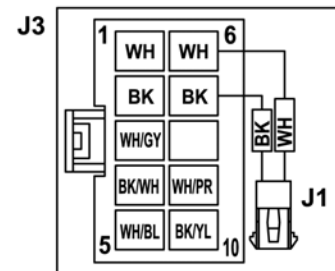
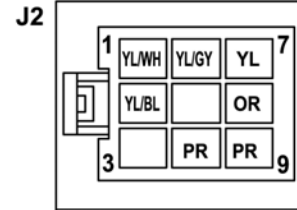
## RELAY BOARD

### Layout, Legend & Diagnostic Test Points

The relay board provides a centralized location for wire harness connections and power transfer through board relays (K1-K4) to the other steamer controls. Also, provides for condition or component troubleshooting by utilizing seven voltage test points (T1-T7) on the board to verify the voltage status for the condition or component in the operating sequence. When the condition for the component's voltage measurement is satisfied or activated, 120VAC can be measured between T1 (ref.) and T2 thru T7 test points to indicate whether the condition or component is receiving voltage to energize and operate. If the voltage is not present, then the condition or component has not been energized or is not activated.



#### CONNECTORS



#### RELAY BOARD CONNECTION LEGEND

TERMINAL	DESCRIPTION
L2	L2 INPUT VOLTAGE TO BOARD (INTERNALLY CONNECTED TO J3(1) )
AUXILLARY	L1 OUTPUT VOLTAGE TO AUX CONTACTORS A & C
CYCLING	L1 OUTPUT VOLTAGE TO CYC CONTACTORS B & D
LLCO	AUX LLCO PROBE INPUT

#### LEGEND

BK - BLACK      GN - GREEN  
 BN - BROWN     PR - PURPLE  
 RD - RED        GY - GRAY  
 OR - ORANGE    WH - WHITE  
 YL - YELLOW

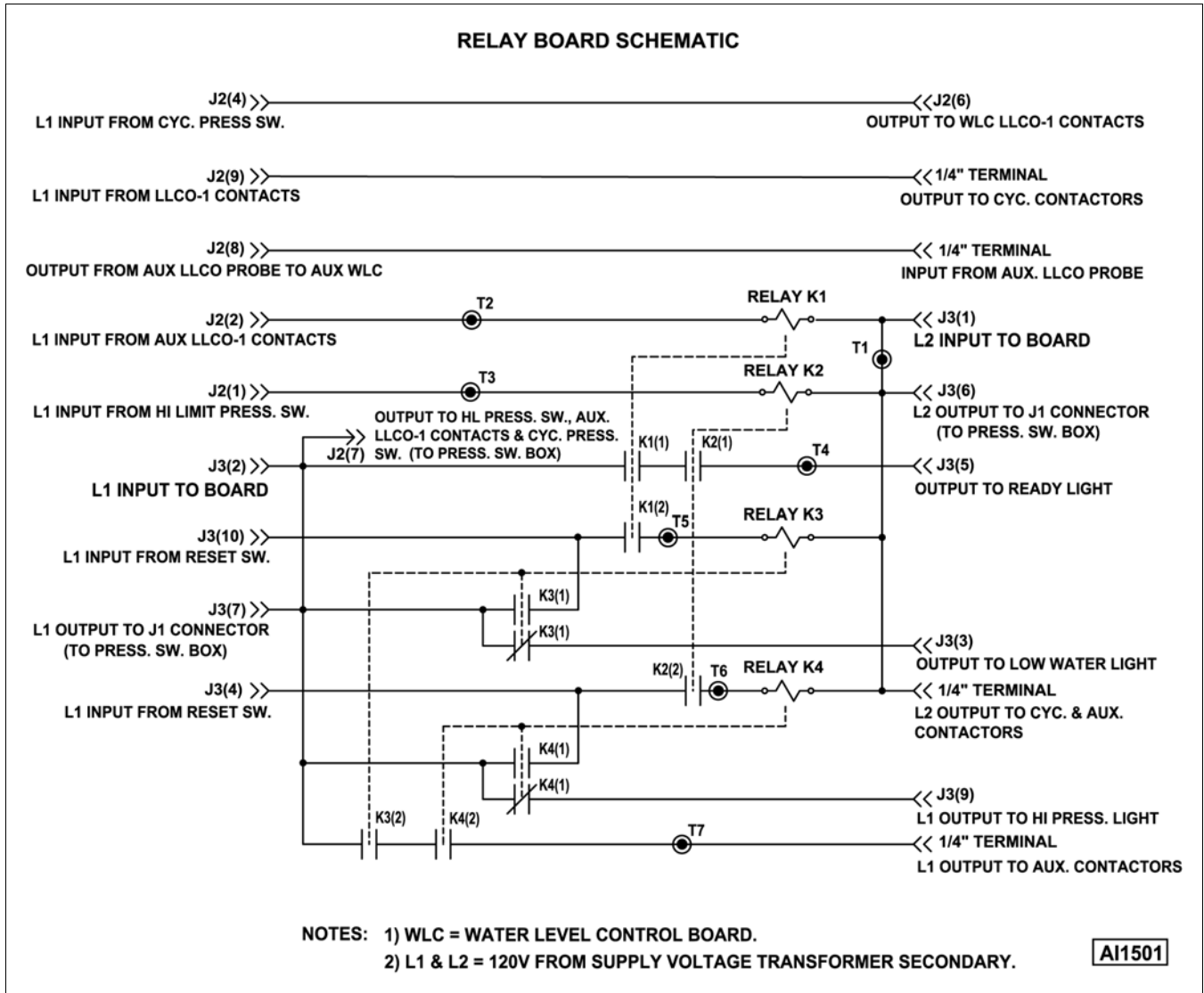
#### RELAY BOARD DIAGNOSTIC TEST POINTS

TEST POINTS	DESCRIPTION
T1-T2	VERIFIES 120V TO RELAY COIL K1 WHEN AUX LLCO-1 N.O. CONTACTS ARE CLOSED (MIN. WATER LEVEL SATISFIED).
T1-T3	VERIFIES 120V TO RELAY COIL K2 WHEN HI LIMIT PRESSURE SWITCH IS CLOSED (PRESS. SWITCH SATISFIED).
T1-T4	VERIFIES K1(1) & K2(1) N.O. CONTACTS ARE CLOSED AND L1 OUTPUT VOLTAGE FROM RELAY BOARD IS PRESENT TO ENERGIZE READY LIGHT.
T1-T5	VERIFIES 120V TO RELAY COIL K3 WHEN K1(2) N.O. CONTACTS ARE CLOSED AND RESET SWITCH SWITCH IS ACTIVATED. WITH K3 ENERGIZED, K3(1) N.C. AND K3(1) N.O. CONTACTS (LATCHING CIRCUIT) CHANGE STATE TO DE-ENERGIZE LOW WATER LIGHT.
T1-T6	VERIFIES 120V TO RELAY COIL K4 WHEN K2(2) N.O. CONTACTS ARE CLOSED AND RESET SWITCH SWITCH IS ACTIVATED. WITH K4 ENERGIZED, K4(1) N.C. AND K4(1) N.O. CONTACTS (LATCHING CIRCUIT) CHANGE STATE TO DE-ENERGIZE HIGH PRESS. LIGHT.
T1-T7	VERIFIES K3(2) & K4(2) N.O. CONTACTS ARE CLOSED AND L1 OUTPUT VOLTAGE FROM RELAY BOARD IS PRESENT TO ENERGIZE AUX CONTACTORS A & C.

NOTES: 1) VOLTAGE MEASURED BEWTEEN T1 (REF.) AND T2 THRU T7 TEST POINTS.  
 2) L1 & L2 = 120V FROM TRANSFORMER SECONDARY.

AI1392

Schematic





## SEQUENCE OF OPERATION

Refer to schematic diagram AI1385 for the electrical sequence of operation.

### Initial Fill and Preheat

1. Conditions.
  - A. Boiler connected to correct supply voltage and is properly grounded.
    - 1) Supply voltage transformer energized and 120VAC is output from transformer secondary.
    - 2) 120VAC to compartment controls and one side of the power switch.
  - B. Power switch off.
  - C. Cycling pressure switch closed.
  - D. High limit pressure switch closed.
  - E. Cold water condenser (CWC) thermostat open.
  - F. Automatic blowdown/drain valve (A.B.D.) open and boiler empty.
  - G. Water supply valve(s) on.
2. Turn power switch on.
  - A. Automatic blowdown/drain valve (N.O.) is energized and closes.
  - B. Water level control (WLC) energized.
    - 1) High level (HL) relay energized, HL-3 N.O. contacts close.
      - a. Boiler fill solenoid energized, water begins filling the boiler (fill time 4-11 min.).
    - 2) LLCO-1 N.O. contacts remain open.
    - 3) HL LED lit.
  - C. Auxiliary water level control (AUX WLC) energized.
    - 1) AUX LLCO-1 N.O. contacts remain open.
  - D. 120VAC to common relay terminal on K1(1) N.O., K3(1) N.O., K3(1) N.C., K3(2) N.O., K4(1) N.O., K4(1) N.C contacts.
  - E. Low Water light lit thru K3(1) N.C.
  - F. High Pressure light lit thru K4(1) N.C.
  - G. K2 energized through the high limit pressure switch (N.C.).
    - 1) K2 contacts K2(1) N.O. & K2(2) N.O. close, no power transferred.
  - H. 120VAC to common terminal on AUX LLCO-1 contacts.
    - I. 120VAC to common terminal on WLC LLCO-1 contacts thru cycling pressure switch (N.C.).
3. Water level reaches LLCO probe for the main water level control and AUX LLCO probe for the auxiliary water level control.
  - A. LLCO relay on water level control energizes, LLCO-1 contacts (N.O.) close
    - 1) LED on board lights.
    - 2) Cycling contactors B & D energized. Heating elements remain de-energized until manual reset switch pressed.
  - B. AUX LLCO relay on AUX water level control energizes, AUX LLCO-1 contacts (N.O.) close.
    - 1) LED on board lights.
    - 2) K1 is energized thru AUX LLCO-1 N.O. contacts.
      - a. K1(1) N.O. and K1(2) N.O. close.
      - b. Ready light on manual reset switch lit thru K1(1) N.O. contacts.
4. Water reaches LL (low level) probe.
5. Water reaches HL (high level) probe.
  - A. Boiler fill solenoid is de-energized.
  - B. HL LED goes out.
6. Manual reset switch pressed.
  - A. K3 is energized.
 

**NOTE:** Relay K3 remains energized through K3(1) N.O. latching circuit.

    - 1) K3(1) N.O. contacts close and K3(1) N.C. contacts open.
    - 2) Low water light goes out.
    - 3) K3(2) N.O. contacts close.
      - a. 120VAC to common side of K4(2) N.O. contacts.
  - B. K4 is energized.
 

**NOTE:** Relay K4 remains energized through K4(1) N.O. latching circuit.

- 1) K4(1) N.O. contacts close and K4(1) N.C. contacts open.
- 2) High pressure light goes out.
- 3) K4(2) N.O. contacts close.
  - a. AUX contactors A & C energized, heating elements powered.

**NOTE:** As boiler heats up and builds pressure, some by-pass water/steam is produced which runs into the steam drain box. This causes the cold water condenser (CWC) solenoid to cycle, cooling the drain water and condensing any steam vapors before exiting the drain. The CWC solenoid is powered through the CWC cycling thermostat.

7. Boiler steam pressure reaches upper limit set point of 12 PSI (Approx. 15 minutes).
  - A. Cycling pressure switch opens.
    - 1) Cycling contactors B & D de-energized and power is removed from heating elements.

8. Boiler steam pressure drops below lower limit set point of 10 PSI and the cycling pressure switch closes.
  - A. Cycling pressure switch continues to cycle between the upper and lower set point limits. This energizes and de-energizes the heating elements to maintain pressure in the boiler.

This sequence continues until one of the following occurs:

- 1) Power switch is turned off.
- 2) Boiler water level drops below the LLCO probe for the main water level control and the AUX LLCO probe for the auxiliary water level control.
- 3) Boiler pressurizes to 15 PSI, causing the high limit pressure switch to open.

**Water Refill (After Initial Fill)**

1. Water level drops below low level probe (LL).
  - A. HL relay is energized.
    - 1) HL-3 (N.O.) contacts close.
    - 2) Boiler fill valve is energized.
    - 3) HL LED comes on.
2. Water reaches LL (low level) probe.
3. Water reaches high level probe.
  - A. HL relay is de-energized.
    - 1) HL-3 (N.O.) contacts open.

- 2) Boiler fill valve is de-energized.
- 3) HL LED goes out.
4. The water refill cycle will occur whenever the water level is below the low level probe and will not affect the operation of either the preheat or cook cycle.

**Boiler Blowdown/drain**

1. Power switch turned off.
  - A. Automatic blowdown valve (N.O.) is de-energized and valve opens to drain the boiler.
  - B. Power is removed from all components except cold water condenser (CWC) thermostat and solenoid valve. The CWC thermostat cycles as necessary to lower the discharge temperature of the water and condense steam going into the drain.

**COOKING COMPARTMENT CONTROLS**

1. Conditions.
  - A. Doors shut (closes the N.O. door switch contacts).
  - B. Cooking timers off.
  - C. Compartment pressure switch contacts open.
2. With boiler at operating pressure.
  - A. Cooking compartment pressure switch closes (approx. 3 PSI).
    - 1) Cooking compartment ready light (green) comes on.
3. Start a cook cycle.
  - A. Insert product into steamer and close door.
  - B. Set a cook time.

**NOTE:** On initial startup, if a cooking timer is set immediately after the ready light comes on, steam solenoid chattering will be heard (oil canning) and the ready lights will flash for several seconds. This condition is caused by the manifold steam pressure being on the fringe of the pressure switch set point. When a cook timer is set, the compartment steam solenoid valve opens causing the manifold steam pressure to drop, slightly below the pressure switch set point. At the same time, steam pressure is still increasing in the boiler. This opposing condition causes a pressure bounce to occur. After the steam pressure passes approximately 4 psi this condition subsides. During normal operation, this condition will not be seen.

- C. Contacts 1/3 of cook timer close and timer motor is energized.

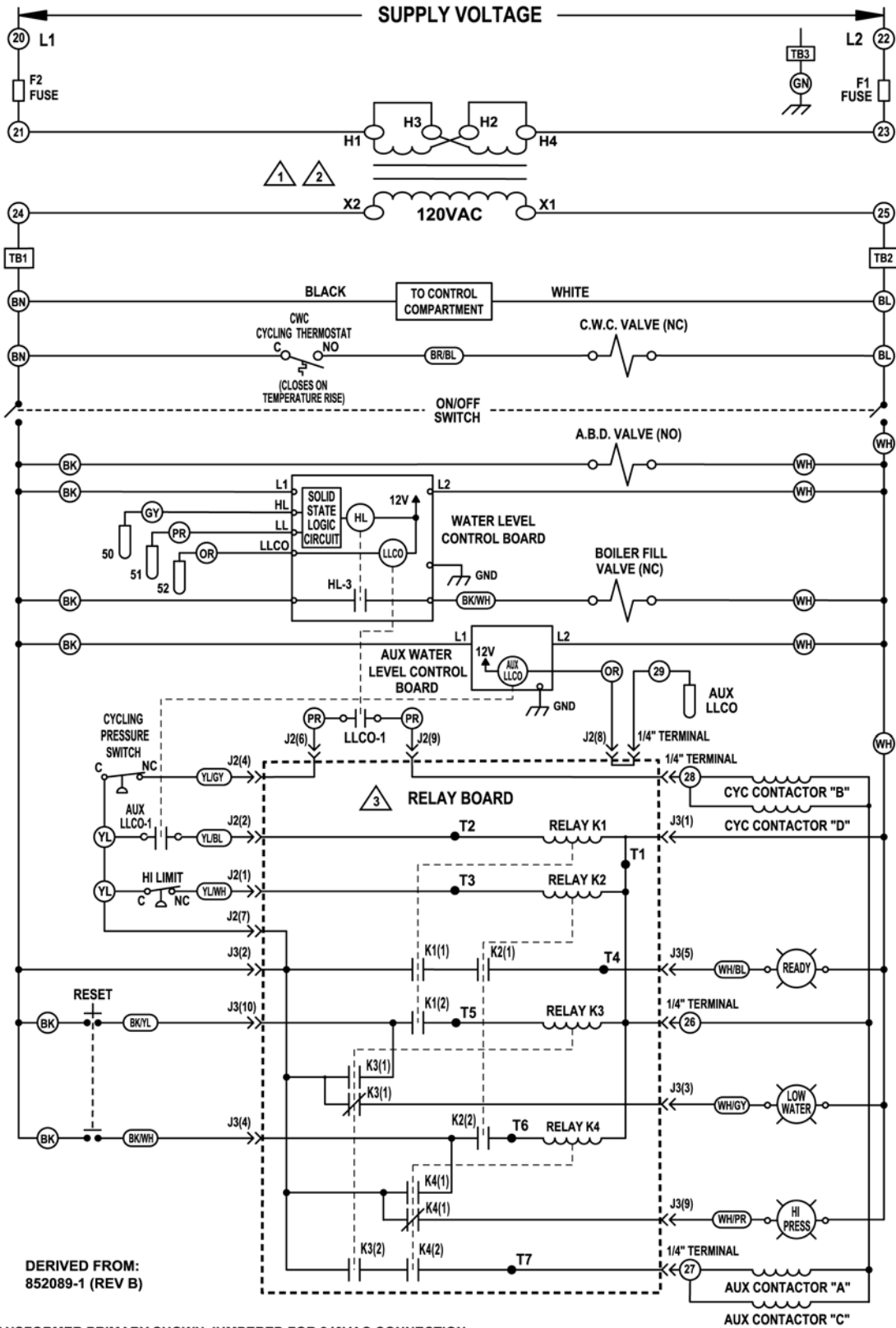
- 1) Compartment steam solenoid valve energized and steam begins to enter the compartment.
- 2) Ready light (green) goes out and Cooking light (red) comes on.

**NOTE:** Steam should not be seen entering either compartment until a cook time is set. This energizes the steam solenoid valve of the cooking compartment to allow steam flow.

4. Time expires on timer.
  - A. Timer contacts 1/3 open, timer motor de-energized.
  - B. Steam solenoid valve de-energizes, stopping the flow steam into compartment.
  - C. Timer contacts 4/1 close and energize buzzer until manually turned off.
  - D. Cooking light (red) goes out and Ready light (green) comes on.
5. Timer manually turned off.
  - A. Contacts 1/4 open.
  - B. Alarm Buzzer de-energized and stops buzzing.
6. Steamer reverts to preheat cycle until time is dialed on timer and the door is shut, water level drops below low level cut-off probe or the power switch is turned off.

**SCHEMATICS**

**Boiler Base Controls**

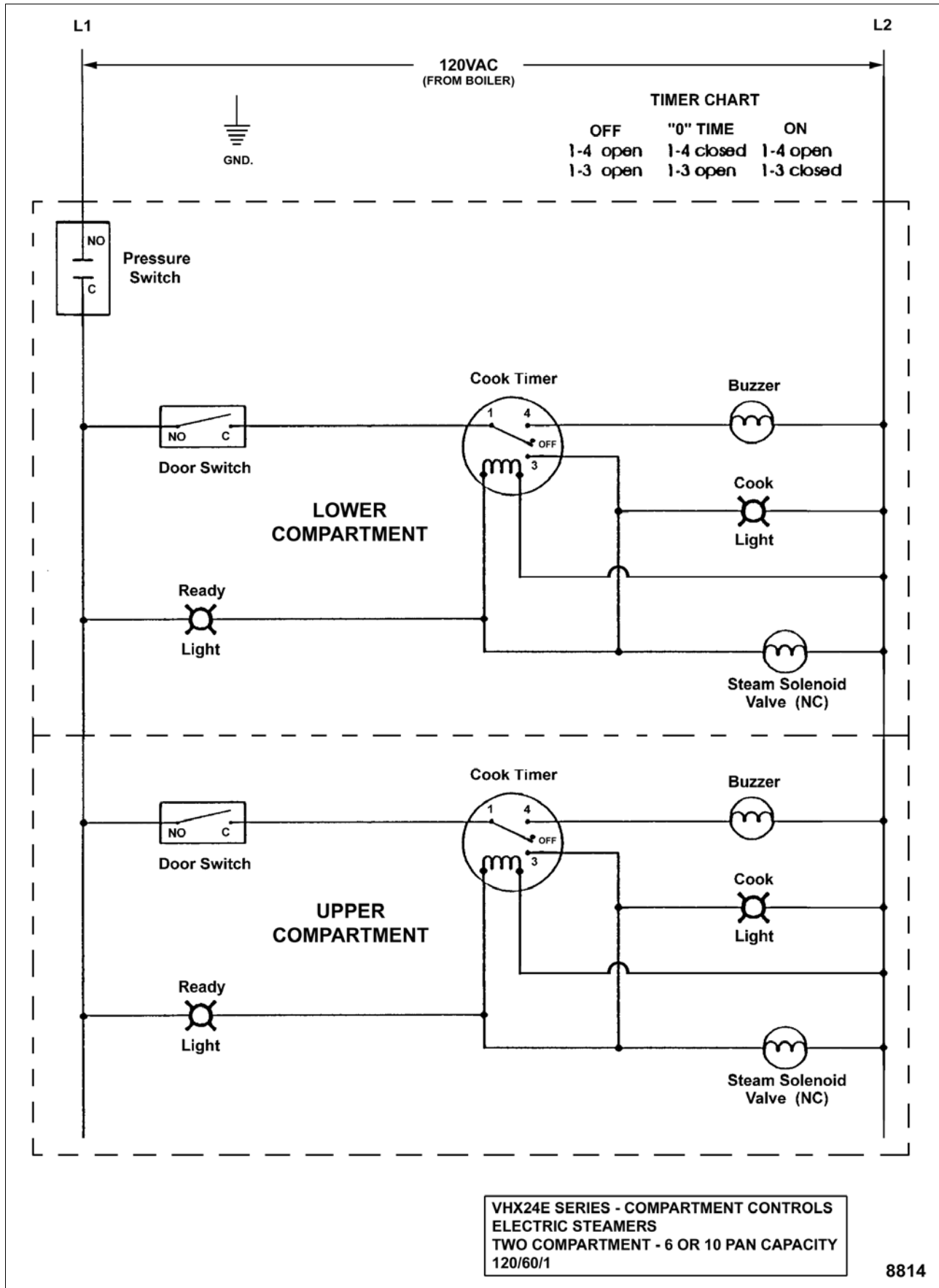


DERIVED FROM:  
852089-1 (REV B)

- 1 TRANSFORMER PRIMARY SHOWN JUMPERED FOR 240VAC CONNECTION (DEFAULT). ON 480VAC ONLY, SINGLE JUMPER IS USED BETWEEN H3 AND H2.
- 2 208VAC STEAMERS USE A 208V TRANSFORMER PRIMARY.
- 3 T1 THRU T7 ARE VOLTAGE TEST POINTS ON THE RELAY BOARD.

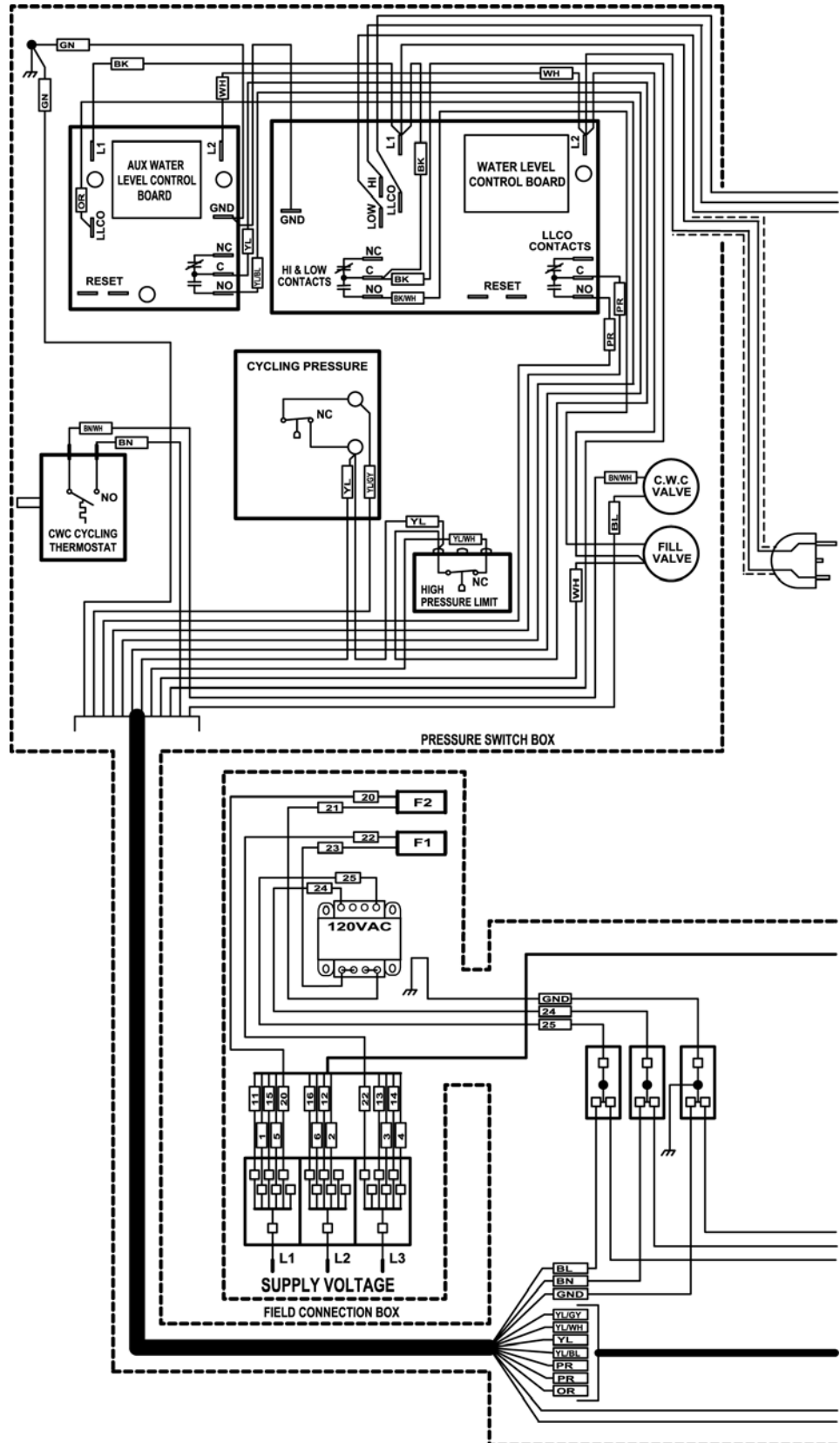
VHX24E, VHX24E5 & MHB24E - BOILER BASE CONTROLS  
SOLID STATE WATER LEVEL AND CSD-1 CONTROLS  
ALL SUPPLY VOLTAGES A11385

Cooking Compartment Controls



**WIRING DIAGRAMS**

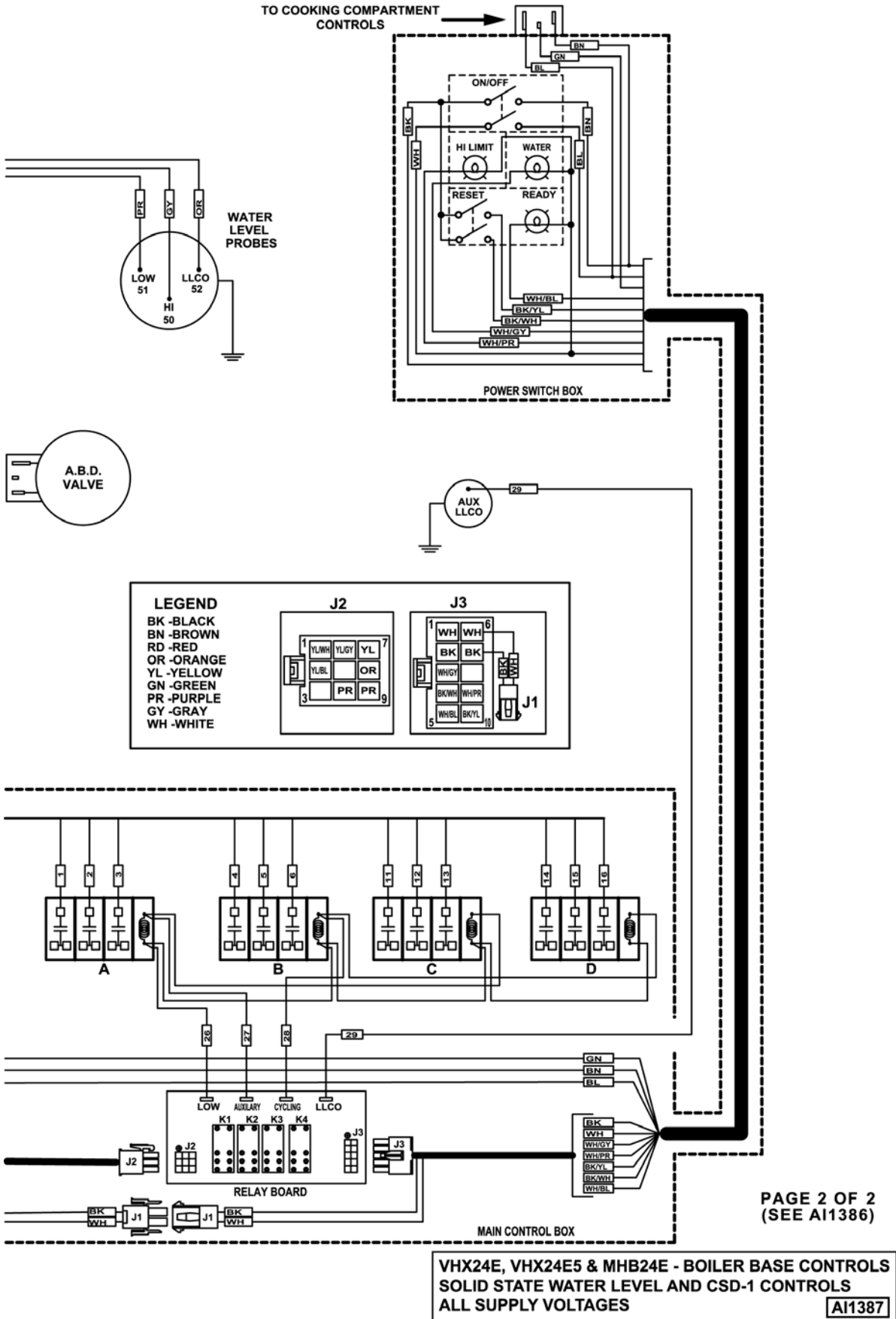
**Boiler Base Controls**



DERIVED FROM 852089-1 REV B  
(WIRING & SCHEMATIC DIA.)  
SEE SCHEMATIC DIA. A11385

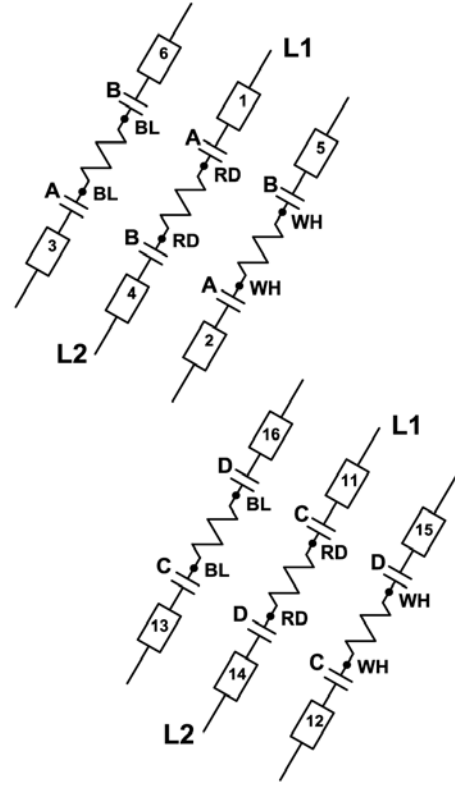
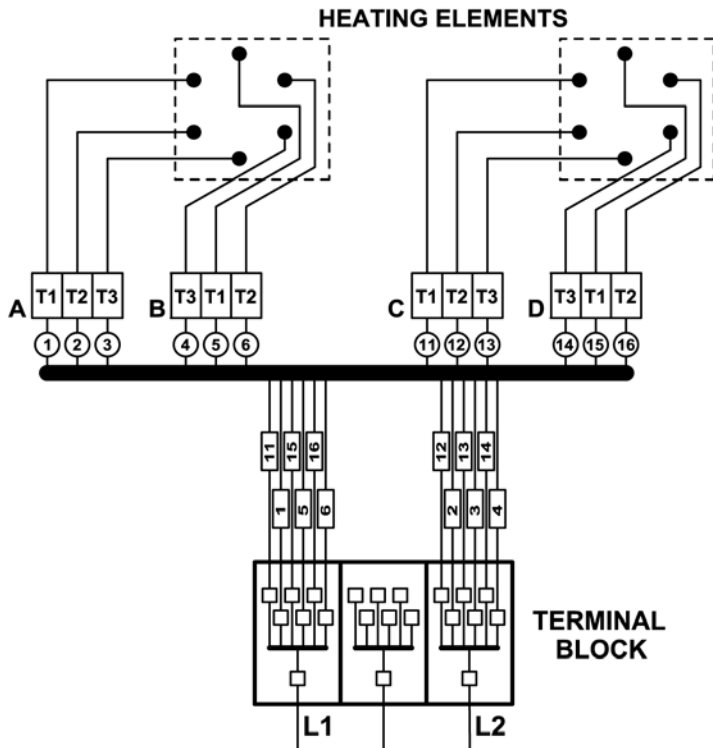
PAGE 1 OF 2  
(SEE A11387)

A11386

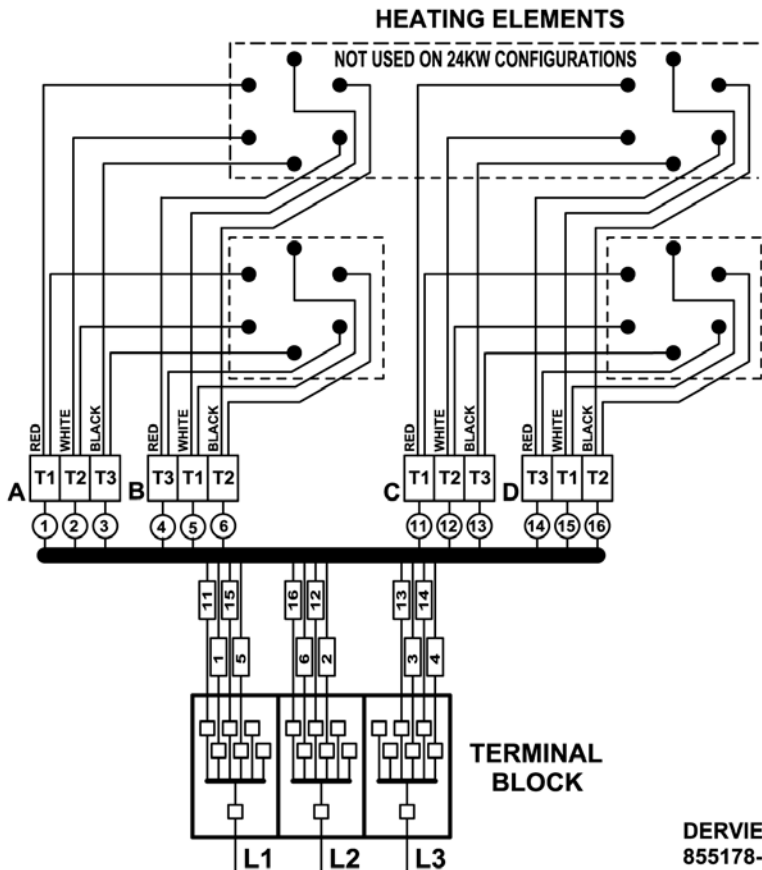


Heating Element Circuits

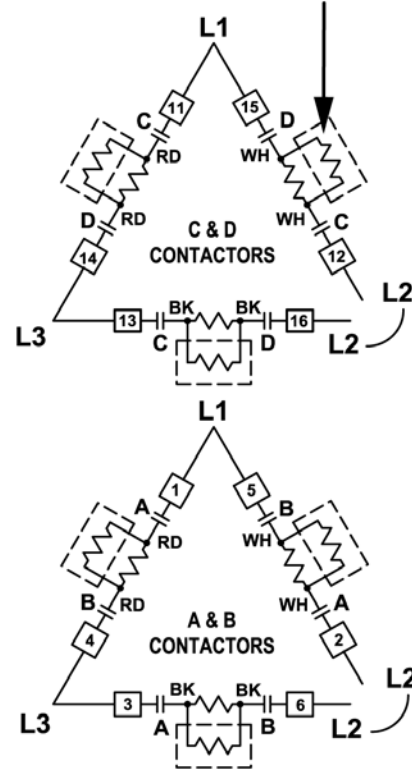
1 PHASE CONNECTIONS (24KW ONLY)



3 PHASE CONNECTIONS (24, 36, 42 & 48 KW)



ON 24KW CONFIGURATIONS ONLY, TWO HEATING ELEMENTS ARE NOT USED (3 INDIVIDUAL ELEMENTS PER HEATER)

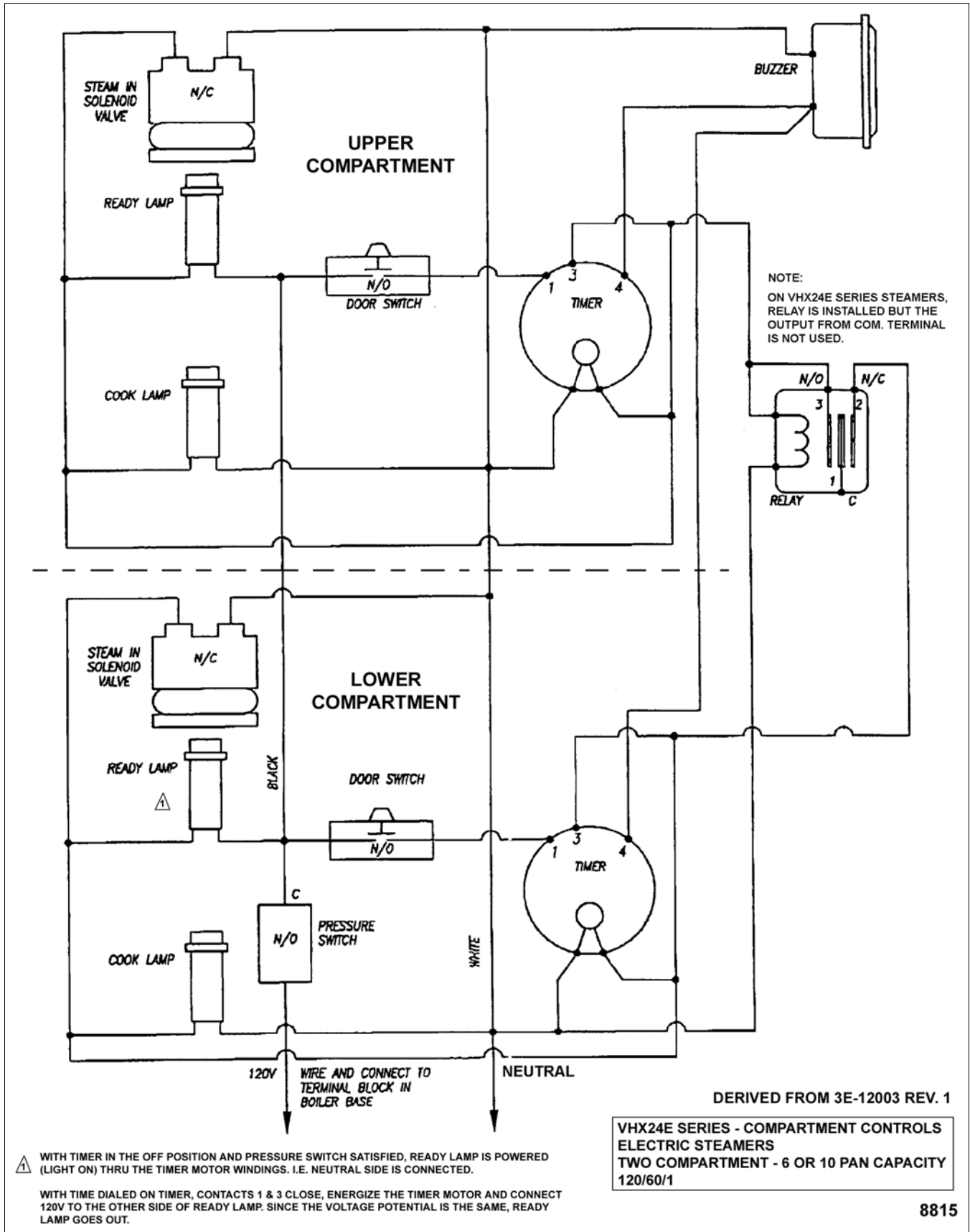


DERIVED FROM:  
855178-1 (REV B)

VHX24E, VHX24E5 & MHB24E  
HEATING ELEMENT CIRCUITS  
208/240/480V - 1 & 3 PHASE POWER **AI1388**



Cooking Compartment Controls



⚠ WITH TIMER IN THE OFF POSITION AND PRESSURE SWITCH SATISFIED, READY LAMP IS POWERED (LIGHT ON) THRU THE TIMER MOTOR WINDINGS. I.E. NEUTRAL SIDE IS CONNECTED.

WITH TIME DIALED ON TIMER, CONTACTS 1 & 3 CLOSE, ENERGIZE THE TIMER MOTOR AND CONNECT 120V TO THE OTHER SIDE OF READY LAMP. SINCE THE VOLTAGE POTENTIAL IS THE SAME, READY LAMP GOES OUT.

# TROUBLESHOOTING

## BOILER BASE CONTROLS

SYMPTOM	POSSIBLE CAUSES
Steamer does not operate, low water light and high pressure lights not lit.	<ol style="list-style-type: none"> <li>1. Main circuit breaker off; or control circuit fuse F1 or F2 open.</li> <li>2. Supply voltage incorrect.</li> <li>3. Supply voltage transformer - jumper missing or incorrect location; or transformer inoperative.</li> <li>4. Power switch malfunction.</li> </ol>
Steamer on, cannot reset low water condition. Low water light lit, ready light not lit, water level not visible in sight glass.	<ol style="list-style-type: none"> <li>1. Boiler fill water off or filtering system clogged.</li> <li>2. Boiler blowdown/drain valve stuck open or malfunction.</li> <li>3. Manual blowdown valve open on water level probe housing.</li> <li>4. Lime scale build-up on water level probes.</li> <li>5. Water level control board - ground connection open, not receiving power or malfunction.</li> <li>6. Boiler fill valve clogged or malfunction.</li> <li>7. Auxiliary water level control board - ground connection open, not receiving power or malfunction.</li> <li>8. Reset switch malfunction.</li> <li>9. K1, K3 relays not seated properly or malfunction.</li> <li>10. Water too pure for probes to properly conduct electricity.</li> <li>11. Interconnecting wiring malfunction.</li> </ol>
Steamer on, cannot reset low water condition. Low water light lit, ready light not lit, water level visible in sight glass.	<ol style="list-style-type: none"> <li>1. Ground connection open on auxiliary water level control board.</li> <li>2. Lime scale build-up dried on AUX LLCO probe.</li> <li>3. Auxiliary water level control board not receiving power or malfunction.</li> <li>4. Reset switch malfunction.</li> <li>5. K1, K3 relays not seated properly or malfunction.</li> <li>6. Interconnecting wiring malfunction.</li> </ol>
Steamer on, cannot reset high pressure condition. High pressure light lit, pressure gauge indicating 15PSI.	<ol style="list-style-type: none"> <li>1. Cycling pressure switch out of adjustment or malfunction.</li> <li>2. High limit pressure switch out of adjustment or malfunction.</li> <li>3. Reset switch malfunction.</li> <li>4. K2, K4 relays not seated properly or malfunction.</li> <li>5. Steam trap malfunction.</li> <li>6. Interconnecting wiring malfunction.</li> </ol>
Boiler operates but pressures are below the normal cycling range of 10-12 PSI.	<ol style="list-style-type: none"> <li>1. Manual blowdown valve on water level probe housing open.</li> <li>2. Boiler blowdown valve clogged and not fully closing.</li> <li>3. Supply voltage incorrect.</li> <li>4. Cycling pressure switch out of adjustment or malfunction.</li> <li>5. Heating elements not wired correctly.</li> <li>6. Contactor(s) malfunction.</li> <li>7. Heating element malfunction.</li> <li>8. Steam trap malfunction.</li> <li>9. Excessive load on boiler due to other equipment connected to steam line (outlet from boiler).</li> </ol>

VHX SERIES STEAMER - TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES
Condenser drain box leaking.	<ol style="list-style-type: none"> <li>1. Grommets or cover panel gasket not sealing.</li> <li>2. Clog in drain line plumbing.</li> <li>3. Drain restricted due to drain pipe size below 1-1/4" NPT.</li> <li>4. Drain extension plumbing not at the proper slope or plumbing too lengthy.</li> <li>5. Steamer drain not plumbed to an open air gap drain.</li> <li>6. Steamer draining while under pressure and relief valve opening at the same time (flooding drain box).</li> <li>7. Cold water condenser spray is over spraying.</li> <li>8. Cold water condenser cycling thermostat out of adjustment or malfunction.</li> </ol>
Excessive steam vapors exiting from drain.	<ol style="list-style-type: none"> <li>1. Water supply for cold water condenser line off or inline strainer clogged.</li> <li>2. Cold water condenser solenoid not receiving power, clogged or malfunction.</li> <li>3. Clogged spray nozzle (condenser drain box).</li> <li>4. Water supply pressure high; or high pressure in line due to water hammer, causing improper valve operation.</li> <li>5. Cold water condenser thermostat out of adjustment or malfunction.</li> </ol>
Heat coming on without water in boiler (Dry firing).	<ol style="list-style-type: none"> <li>1. Lime scale build-up on water level probes.</li> <li>2. Retention of water in probe housing (three probe assembly or single AUX LLCO probe).</li> <li>3. Air equalization tubes clogged.</li> <li>4. Water level control malfunction.</li> <li>5. Auxiliary water level control malfunction.</li> <li>6. Reset switch malfunction.</li> <li>7. K1, K2, K3, K4 relays malfunction.</li> <li>8. Relay board malfunction.</li> </ol>
Excessive time for boiler to reach operating pressure (over 15 min.).	<ol style="list-style-type: none"> <li>1. Supply voltage incorrect.</li> <li>2. Heating elements not wired correctly.</li> <li>3. Contactor(s) malfunction.</li> <li>4. Water supply off or low pressure, filtering system clogged, boiler fill valve clogged or malfunction.</li> <li>5. Manual blowdown valve on water level probe housing open.</li> <li>6. Boiler blowdown/drain solenoid valve clogged and not fully closing.</li> <li>7. Steam trap malfunction (stuck open).</li> <li>8. Pressure relief valve leaking (pressure below 15PSI).</li> <li>9. Cooking compartment steam solenoid valve clogged and not fully closing.</li> <li>10. Excessive load on boiler due to other equipment connected to steam line (outlet from boiler).</li> <li>11. A heavy build-up of scalants has coated the interior of the boiler, creating an insulating effect.</li> </ol>

VHX SERIES STEAMER - TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES
<p>Steamer on, boiler will not heat. Reset switch activated, low water light and high pressure light not lit, ready light lit.</p>	<ol style="list-style-type: none"> <li>1. Reset switch malfunction.</li> <li>2. Water Level Control malfunction.</li> <li>3. Cycling pressure switch out of adjustment or malfunction.</li> <li>4. High limit pressure switch out of adjustment or malfunction.</li> <li>5. K3, K4 relays malfunction.</li> <li>6. Relay board malfunction.</li> <li>7. Contactor(s) malfunction.</li> <li>8. Interconnecting wiring malfunction.</li> </ol>
<p>Pressure relief valve opening or leaking.</p>	<ol style="list-style-type: none"> <li>1. Pressure relief valve malfunction.</li> <li>2. Cycling pressure switch out of adjustment or malfunction.</li> <li>3. High limit pressure switch out of adjustment or malfunction.</li> </ol>
<p>Steam output low or slow cooking.</p>	<ol style="list-style-type: none"> <li>1. Cooking Compartments.               <ol style="list-style-type: none"> <li>A. Blocked steam injector ports. Open door, press door switch button and verify good steam flow into compartment.</li> <li>B. Steam solenoid valve clogged or malfunction.</li> <li>C. Steam intake shut-off valve not adjusted properly.</li> </ol> </li> <li>2. Boiler Base.               <ol style="list-style-type: none"> <li>A. Cycling pressure switch out of adjustment or malfunction.</li> <li>B. Steam header line (supply) blockage.</li> <li>C. Excessive amount of water in condensate tube loop from boiler to pressure controls.</li> <li>D. Pressure relief valve leaking.</li> <li>E. Excessive steam supply line leaks.</li> </ol> </li> </ol>
<p>Steamer leaks water.</p>	<ol style="list-style-type: none"> <li>1. Water, steam or drain line connections loose (top or base).</li> <li>2. Heating element gasket not sealing.</li> <li>3. Heating element mounting plate not sealing.</li> <li>4. Gauge glass fittings loose.</li> </ol>
<p>Boiler water level too high, more than 1" visible in sight glass.</p>	<ol style="list-style-type: none"> <li>1. Boiler fill valve malfunction.</li> <li>2. Water level probes not wired correctly.</li> <li>3. Lime scale build-up on HL probe.</li> <li>4. Water level control malfunction.</li> </ol>
<p>Boiler does not fill or is slow to fill.</p>	<ol style="list-style-type: none"> <li>1. Boiler fill water off or filtering system clogged.</li> <li>2. Manual blowdown valve on water level probe housing open.</li> <li>3. Boiler fill valve not receiving power, clogged or malfunction.</li> <li>4. Boiler blowdown/drain valve clogged and not fully closing.</li> <li>5. Air equalization tubes clogged.</li> <li>6. Water level control malfunction.</li> </ol>

**COOKING COMPARTMENT CONTROLS**

<b>SYMPTOM</b>	<b>POSSIBLE CAUSES</b>
Cooking compartments do not operate.	<ol style="list-style-type: none"> <li>1. No power to cooking compartment controls.</li> <li>2. Pressure in boiler is below compartment pressure switch setting.</li> <li>3. Manual intake shutoff valve in the off position.</li> <li>4. Door switch malfunction.</li> <li>5. Timer malfunction.</li> <li>6. Malfunctioning pressure switch in compartment.</li> <li>7. Interconnecting wiring malfunction.</li> </ol>
Steam generated inside compartment when timer is off.	<ol style="list-style-type: none"> <li>1. Steam supply solenoid not fully closing (clogged or dirty).</li> <li>2. Timer contacts 1 &amp; 3 closed.</li> </ol>
Timer motor does not run.	<ol style="list-style-type: none"> <li>1. Door open or door switch malfunction.</li> <li>2. Timer not receiving power or malfunction.</li> </ol>
Door not closing properly.	<ol style="list-style-type: none"> <li>1. Door latch assembly malfunction or out of adjustment.</li> <li>2. Striker adjustment.</li> </ol>
Door won't open.	<ol style="list-style-type: none"> <li>1. Latch won't release.</li> </ol>
Buzzer not operating.	<ol style="list-style-type: none"> <li>1. Timer malfunction.</li> <li>2. Buzzer malfunction.</li> </ol>
Compartment leaks water around door or water accumulating in compartment .	<ol style="list-style-type: none"> <li>1. Compartment drain screen clogged.</li> <li>2. Door out of adjustment.</li> <li>3. Drain line obstructed or not to an open air gap drain.</li> <li>4. Worn or damaged door gasket.</li> <li>5. Steamer not level.</li> </ol>
Steam leaks around door.	<ol style="list-style-type: none"> <li>1. Door out of adjustment.</li> <li>2. Worn or damaged door gasket.</li> <li>3. Drain line obstructed or not to an open drain.</li> </ol>

**– NOTES –**

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**CONDENSED SPARE PARTS LIST****VHX24E, VHX24E5, MHB24E**

<b>BOILER BASE</b>		
<b>PART NUMBER</b>	<b>DESCRIPTION</b>	<b>NOTES</b>
855051-1	Element, 9kw 208V	
855051-2	Element, 9kw 240V	
855051-3	Element, 9kw 480V	
855051-4	Element, 10.5kw 208V	
855051-5	Element, 12kw 208V	
855051-6	Element, 12kw 240V	
855051-7	Element, 12kw 480V	
881237	Fuse, 10 Amp 600v Time Delay	
881236	Fuse Holder	
880410	Gasket, heating element	
880413	Valve, Pressure Relief 15 psi	
817222	Valve, Cold Water Condenser and Boiler Fill	
833488	Switch, Pressure Cycling	
851578-1	Switch, Pressure High Limit	
844062-1	Thermostat, Condenser/drain Box	
854839-1	Contact, 50 Amp	
855223-1	Relay Board (Includes relays)	
855225-1	Relays	
844070-1	Control, Aux. Low Water Board	
844069-1	Control, Low Water Board	
851613-1	Valve, Boiler Blowdown/drain	
855177-2	Transformer 240-480/120 250VA	
855177-3	Transformer 208/120 250VA	
853275-1	Switch Assembly (Power, Reset W/lights)	

<b>COOKING COMPARTMENT</b>		
<b>PART NUMBER</b>	<b>DESCRIPTION</b>	<b>NOTES</b>
842049	Door Switch	
843833	Transducer	
843832	Pressure Switch	
411690-1	Timer 60 Min 120v	
843836	Solenoid, Steam Inlet	
844196	Gasket, Door 3 Pan Compartment	
844385	Gasket, Door 5 Pan Compartment	